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CONTENTS

VA goes better with Lux!

Orthoptists display an extraordinary diversity of talent, skill and expertise in this edition of the *Australian Orthoptic Journal* that closes the twentieth century. The research reported forms not only the components of honours and graduate studies but also clinical trials in the public health care system, screening in the public education sector and enterprise screening for private corporations. Reports from private clinical practice provide anticipated controversy. A concise case exposé by Rando reminds us of the differences between the superior orbital fissure syndrome and the carotid-cavernous fistula.

Whilst it doesn't adopt as high a profile as some forms of research due to its lack of innovation and foreground noise, the project that questions validity and explores clinical variables in their pure and isolated form is often the best reminder to us in our day to day practice of unintentional and common sources of error. The study on room illumination and visual acuity measurement by Wozniak et al is an excellent example of such. Remind yourself of the differences between illumination, luminance and contrast, last considered as first year physical sciences subjects, and note the relevance it has not only to your VA measures, but to your monitoring of treatments over time, expecially in clinics where testing rooms are interchangeable. This paper has the best treatment of the Snellen Acuity scale into a pseudo linear measure that I have encountered. Future researchers will be indebted. Vision screeners have just had their data nightmares eliminated. VA definitely goes better with lux!

Giribaldi and Wulff have brought enterprize eye health care screening for the corporate sector to the fore. This paper provides a blueprint for employee screening. Test types, outcomes and referral types and rates are displayed with actions taken for remedies. This study has implications for workplace recommendations. Screening is usually performed at formative visual ages to detect and treat pathology, while this study addresses environmental and workplace conditions in tandem with the binocular visual system of adults. Jones presents the more familiar vision screening programme that has been part of the orthoptist's role for several years now. A difference lies however in the adjunct look at the state of the eyes of children in Grade 5 in the public schooling system. You may be surpised by the findings. The protocol for screening of staged assessments utilizing school nurses with the orthoptist as a second round screening appears to be efficient and effective.

Vision levels sufficient to live in the community form the core of papers by Haynes et al and also by Fitzmaurice. Shopping, cooking, cleaning, walking, using transport, taking medicines, eating, reading, watching TV or sewing are activities that have been used to measure different levels of independence. Adequate performances of these activities are the measures and goals of those working in the field of visual rehabilitation. Monetary and social costs to the community of disabling levels of visual impairment are now recognized. Fitzmaurice investigates modes of treatments in this field across Australia, including eccentric viewing, null point and hemianopic training. Haynes reminds us that although cataract blindness is one of the leading causes of treatable blindness, we need to be cogniscant of activities of daily living indicators, not only as well as but perhaps instead of the usual measures pre and post operatively of visual acuity. This is the second part of her and her colleagues' investigations into this field, part one having been published in volume 33. Outcome measures were assessed using the VF14 questionnaire for visual impairment and were compared with post operative VA scores. The two indicators corresponded in the majority of respondents but not in all instances. Satisfaction scores were the lowest. Is the patient's perception of their health the most valid measure of outcome? How do we assess this validity?

This extremely difficult area leads us to the paper by Lawson et al. Dyslexia per se is probably one of the most controversial states of consciousness ever encountered in the medical and associated fields. The borders of its definitions have never been fixed, its causes have countless hypotheses, and its managements have been as vast and diverse as any number of aspects of general care. The aspect of ocular health within this paradigm has been no less problematic. Lawson et al present a treatment modality – the Lawson Anti-suppression Device (LASD) for patients with learning difficulties. Signs and symptoms are listed, methods of training are outlined and results tabled. There is no doubt that effects are being seen in this group. There are many questions to ask of a study that has no controls or alternative treatment protocols that account for effects such as the Hawthorne, Rosenthal, or placebo effects or the bias of examiners, patients or carers. There is enough indication in this paper of an effect, but what is its source, be that single or multifactorial?

Letters are welcome for journal 2000.

The Effect of Room Illumination on Visual Acuity Measurement

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Abstract

Although a number of parameters have been standardized when testing visual acuity (including chart distance, optotypes and luminance of the chart), there is considerable variation in room lighting conditions used. Currently no research exists which either suggests a particular room illumination, or even if there is any difference in visual acuity with different room lighting conditions. The purpose of the current study was to determine whether changes in room illumination affect the level of distance visual acuity recorded. Visual acuity was randomly tested on 50 subjects (98 eyes) using the standard Snellens chart in two different room illumination levels, with normal room illumination (with room lights on - 1300 lux) and with reduced room illumination (with room lights off - 90 lux). Residual refractive error (difference between spectacle correction and autorefraction) was calculated and pupil size measured in each condition. Overall a significant difference in visual acuity between the two lighting conditions was found with visual acuity levels improving with room illumination (6/9+4 in illuminated room, 6/9+2 in non-illuminated room; $t=4.653$, $p<0.001$). The difference was found to be greater in the non-emmetropic group (6/12+3 in illuminated room, 6/12 in non-illuminated room). There was a small subgroup of subjects' eyes where the visual acuity level dropped by more than one line in the non-illuminated room ($n=18$). The reason for this difference may be related to optical influences on visual acuity such as accommodation and night myopia.

Key words:
Visual acuity, illumination.

Introduction

The measurement of visual acuity forms a fundamental part of clinical practice and is an important measure for conducting research into many aspects of the visual system. Visual acuity needs to be performed in a reproducible fashion especially when it is the primary variable used to assess change in visual function over time or after application of a form of treatment. Guidelines for standardizing the measurement of visual acuity have been suggested including recommendations for the type, spacing and number of optotypes, standardizing the chart lighting, instructions for the testing procedure and scoring of the visual acuity result[1], but seemingly little attention has been placed on standardization of the room illumination.

There is a need to define the terms related to lighting levels when testing visual acuity-illumination, luminance and contrast. Illumination refers to the intensity of light falling on a subject and is measured in lux (the international unit of illumination). The illumination on a surface at 1 metre distant from a point source of 1 candela is 1 lumen /m^2 known as 1 lux. The illumination at 1 foot from a source of 1 candela is 1 lumen /ft^2 which is equal to 10.764 lux as there are 10.764 square feet in 1 square metre. This was previously known as the foot candle, quoted in the early literature describing illumination required for the testing of visual acuity prior to the advent of internally illuminated vision charts and projected charts. Illumination of around 12 to 18 foot candles was considered the standard illumination for visual acuity charts.[2,3] This standard was questioned by several authors who noted that visual acuity decreased with decreasing illumination,[4,5] and that lower illumination levels were required to detect subtle visual abnormalities such as refractive errors. It was also stated that many occupations required personnel to work in much lower levels of illumination and perhaps the standard should be varied depending on the purpose for measurement of visual acuity.[4]

In the early '80s when the Early Treatment Diabetic Retinopathy Study (ETDRS) was conducted, new visual acuity charts were designed that had a standard progression of letter size and spacing between lines.[6] These charts are known as the logarithmic Minimum Angle of Resolution (logMAR) chart. Illumination was standardised by either direct illumination (onto the chart externally) at a level of between 807 to 1345 lux or retroilluminated.[7]

With use of retroilluminated charts it became necessary to standardise the luminance of the chart. Luminance refers to the intensity of light emitted from a surface (such as that reflected by an internally illuminated vision chart) and is expressed in "nit", the international unit of luminance, equal to 1 candela per square metre (cd/m^2).[8] The normal photopic range of luminance is 40-600cd/m^2. There is ample evidence to show that there is a reduction in visual acuity as chart luminance reduces.[9,10,11] Rabin[9] showed that reducing the luminance from 116 to 0.23 cd/m^2 by using neutral density filters over the subjects' eyes produced a 3 times reduction in visual acuity.

In a study by Sheedy Bailey and Raasch[11] the luminance standards across the world were compared and the effect of luminance on visual acuity across a wide range of luminance levels was evaluated. In the photopic luminance range a doubling of luminance levels was found to improve visual acuity by approximately one letter on a five-letter row. They recommended chart lighting to be 160cd/m^2 with a range of 80-320 cd/m^2. These are the standards that are also recommended by the United States Food and Drug Administration.[1]

A third aspect to be considered when testing visual acuity is the contrast level, which is defined as the ratio between target luminance over target and background luminance. For visual acuity it is recommended that there be "high contrast between optotypes and background".[1,p181] Visual acuity is affected when contrast drops below 70% so it is important to keep contrast above this level when measuring visual acuity. The effect of contrast on vision is best evaluated by the use of contrast sensitivity testing procedures. Previous researchers have studied the effect of luminance, age and refractive errors on visual acuity performance, but not room illumination.[3,9,10,11,15,16,18,19]

The British Standards Institute specifies a uniform external illumination of at least 480 lux.[12] When a sample of 45 schools where evaluated to determine whether standard conditions were used for visual acuity testing for school screening 89% were found to not be able to meet this illumination requirement.[13] Researchers conducting multicentre trials have also encountered problems when setting room illumination standards for visual acuity testing. The Scleral-Primary-Rhegmatogenous study (comparing treatment for retinal detachment at 24 centres in Europe) has adopted a level of not greater than 150 lux (H. Heimann personal communication 19th March 1999, M Hellmich personal communication 6th April 1999). Currently practices in Australia use a variety of methods to test visual acuity, many using the standard Snellens chart with varying room illumination. Some practitioners prefer to use fluorescent room lights with others dimming or turning off room lights. The aim of the current research was to evaluate whether different room illumination levels affect the measurement of visual acuity.

Method

1. Subjects

A total of 50 subjects (98 eyes) was chosen from the population available to the researchers, and mainly consisted of fellow students and staff at the Faculty of Health Sciences, University of Sydney. The age ranged from 18 to 58 years with a mean age of 26 yrs, SD of 12.3 years. Nine of the subjects wore glasses. Recordings were excluded if any of the following were present: aphakia, cataract, anomalies of accommodation, medication that may affect visual acuity, the squinting eye in strabismus and amblyopia.

2. Testing Procedure

Before testing, each subject was asked about their ocular history to determine if they were suitable for the study. The uncorrected refractive error of each subject was obtained objectively using the Humphrey Autorefractor (Hark Model 599). When glasses were worn the prescription was determined using a Topcon LM-P6 vertometer, and the difference between the glasses prescription and autorefraction results was recorded as the residual refractive error. For example for glasses of -2.00, and an autorefraction recorded -2.50; a residual refractive error of -0.50 was calculated.

Visual acuity was measured monocularly in the same room under the same testing conditions for all subjects. The luminance of the vision box was in the range of 180 to 220cd/m^2 produced by two 40watt pearl light bulbs. A chart and lighting system enclosed in a wooden box was used so that extraneous light did not interfere with the results.

Vision was tested at 6 metres using two Snellen charts in a random order to eliminate any learning effect. The subjects were randomly placed in one of two lighting conditions: an illuminated room with the room lights on (1300 lux) and a non-illuminated room with the room lights off (90 lux). Outside light was completely eliminated. Visual acuity was measured using standard instructions and pupil diameter was also measured. Subjects who wore glasses were tested while wearing their glasses. The Snellens chart was changed and alternative room lighting was used and again pupil diameter was measured. Subjects were given one minute to adapt to the new conditions prior to testing their visual acuity. Subjects were then asked to comment on which lighting condition they preferred.

3. Analysis

For the purpose of statistical analysis the subject's refractive error (autorefraction results in the case of non-glasses wearers, residual refraction for glasses wearers) was converted into the spherical equivalent. The mean residual refractive error was -0.61D with a range of -4.88D to +1.19D.

Snellens acuity scores were converted to a decimal equivalent ranging from 1 (6/60) to 8 (6/5). (See Table 1 for these conversions.) This conversion produced a pseudo-linear scale for statistical analysis.

A paired t test and ANOVA were used for statistical analysis. It should be noted that although a number of statistical tests were undertaken, a very high level of significance was obtained. Therefore no adjustment was made to control for the family-wise error rate.

Results

1. Overall difference in visual acuity

A paired t test showed that there was a significant difference between visual acuity in the two lighting conditions ($t(97) = 4.653$, $p<0.001$). The mean visual acuity in the illuminated room was greater than in the non-illuminated room. Table 2 shows the overall means and their standard deviations. The SD was large as there was a large range in visual acuity levels recorded; from 3/60 to 6/5.

2. Pupil size

Pupil size increased in the non-illuminated room; mean pupil size in the illuminated room was 3.3mm SD 0.79, and mean pupil size in the non-illuminated room was 4.8mm SD 1.1. This difference was also found to be significant ($t(97) = -12.084$, $p<0.001$).

Snellen Acuity	Letters on the Snellen Chart							
	1	2	3	4	5	6	7	8
6/60	1							
6/36	1.5	2.0						
6/24	2.33	2.67	3					
6/18	3.25	3.5	3.75	4				
6/12	4.2	4.4	4.6	4.8	5			
6/9	5.17	5.33	5.49	5.65	5.81	6		
6/6	6.14	6.29	6.43	6.57	6.71	6.86	7	
6/5	7.125	7.25	7.375	7.5	7.625	7.75	7.875	8

Table 1. Conversion scale for Snellen Acuity Chart.

Group	Mean VA in illuminated room	Standard Deviation	Mean VA in non-illuminated room	Standard Deviation
All subjects	6.57 (6/9+4)	2.2	6.3(6/9+2)	2.3
Emmetropes	7.45 (6/6+4)	1.5	7.4(6/6+3)	1.5
Non-emmetropes	5.53(6/12+3)	2.4	5.01(6/12)	2.4
Hypermetropes	7.48(6/6+4)	1.01	6.95(6/6)	1.02
Myopes	5.29(6/12+2)	0.36	4.77(6/12-1)	0.36

Table 2. Mean visual acuity for all groups in the illuminated and non-illuminated room.

3. Effect of refractive error

Residual refractive error was examined in two ways. Firstly emmetropes and non-emmetropes were compared, and secondly the non-emmetropic group was divided into hypermetropes and myopes and then compared.

3.1. Emmetropes and non-emmetropes

Subjects with a spherical equivalent refractive error between +0.50 and -0.50 were classified as emmetropes (n=53) and all others non-emmetropes (n=45). A significant interaction existed between emmetropes and non-emmetropes across the illuminated room and non-illuminated room conditions ($F(1,96)=18.699$, $p<0.001$, Figure 1). Post-hoc analysis revealed that no difference existed between the lighting conditions for the emmetropes, but a significant difference occurred across lighting conditions for the non-emmetropes ($t(44)=5.964$, $p<0.001$). Visual acuity was greater in this group in the illuminated room condition, over the non-illuminated room condition (Figure 1, Table 2).

3.2. Myopes and hypermetropes

To determine if the type of refractive error influenced the visual acuity results in both conditions the non-emmetropic group was then divided into myopes, subjects with a spherical equivalent greater than -0.50 (n=40) and hypermetropes, subjects with a spherical equivalent of +0.50 or greater (n=5). No significant interaction was found between myopes and hypermetropes across room illumination. A significant effect of the illumination condition was found, with improved visual acuity in the illuminated condition over the non-illuminated condition ($F(1,43)=13.614$, $p<0.001$; Figure 2, Table 2). Although a significant effect of myopes versus hypermetropes was found, the degree of effect was marginal ($F(1,43)=4.142$, $p=0.048$; Table 2). This low level of effect may have been due to the small number of hypermetropes. Further, without correction for the family-wise error rate this result should be considered as a possible artifact.

Figure 1. Mean visual acuity for emmetropes and non-emmetropes in both lighting conditions.

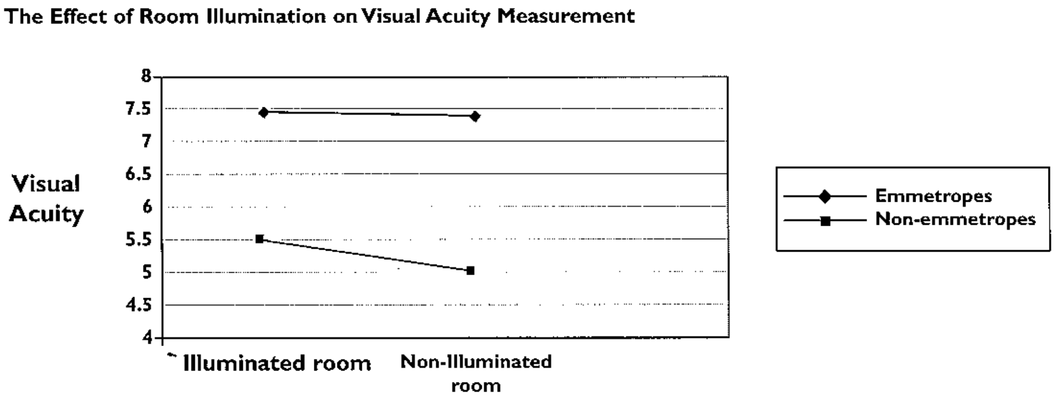
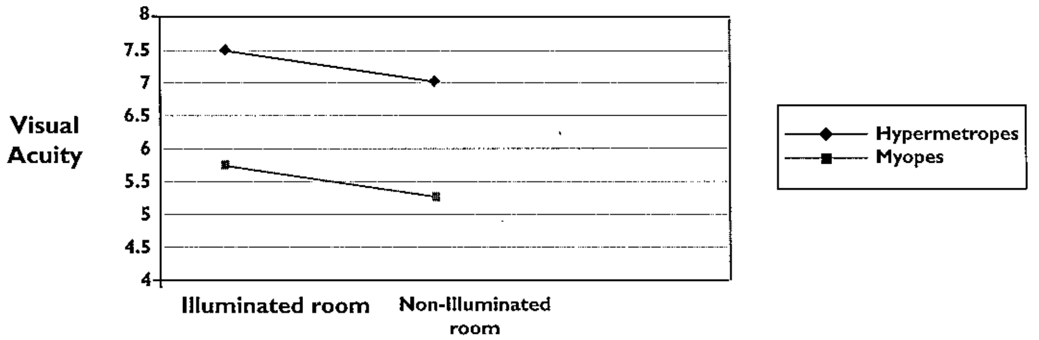


Figure 2. Mean visual acuity for hypermetropes and myopes in both lighting conditions.



4. Selected cases

There were 19 eyes that showed a greater than 1 line change of visual acuity between conditions with all but one showing a decline in visual acuity in the non illuminated condition. These cases did not significantly differ from those where there was a less than one line difference in visual acuity when age, pupil diameter and residual refractive were compared. It appears that there is a small but important subset of subjects where visual acuity can be more profoundly influenced by changes in room illumination.

5. Subject preference

Subjects were asked to comment on which lighting condition they found better or easier to see the letters. Seventy eyes of the subjects preferred the room lights on, fourteen found no difference between lighting conditions and fourteen preferred the room lights off.

Discussion

Overall the current study found a statistically significant difference in visual acuity between the two lighting conditions with visual acuity levels improving with room illumination. The difference was found to be greater in the non-emmetropic group. The difference found was small, around 4 letters on the Snellens chart, so there is some question as to the clinical significance of this result. Considering the variable nature of measuring this psychophysical function one may expect a variation of plus or minus one letter on a five-letter row.[11] However, it does appear that there is a small but important subgroup of subjects where room illumination will affect the visual acuity level recorded with over one line of worsening in dimmer illumination.

Recently (following completion of the collection of data for the current study) Kundhart and Hatch examined the visual acuity of 37 normal subjects using a projected chart in three different room illumination levels 300-440 lux, 100-200 lux and 1-50 lux.[14] No significant difference was found between mean visual acuity in the three lighting levels (logMAR -0.078, -0.097 and -0.100 at bright, medium and dim lighting levels respectively, p=0.234). In fact a slight improvement in visual acuity was found in dim lighting conditions contrary to the current study. This difference in results may be because the researchers measured visual acuity binocularly using a projected logMAR chart and all subjects had 6/6 visual acuity. Interestingly they also found a small subset of 3 subjects with a one-line or greater reduction of visual acuity with decreased room illumination.

The difference in visual acuity found between the two lighting conditions in the current study may be due to optical factors including pupil diameter, refractive error and accommodation. The decrease in visual acuity in the non-illuminated room could be accounted for in part by the dilation of the pupil. Pirenne[15] however, using artificial pupils and more recently Rabin[9] using natural and artificial pupils, showed that the reduction in visual acuity in lower luminances was the same regardless of pupil size.

In this study there did appear to be a relationship between the visual acuity in the non-illuminated room and the presence of a residual refractive error, with visual acuity worse in the non-emmetropic group. Others have also found this result. For example Ferree[4, p247] using very small simulated astigmatic errors of only 0.25 dioptres found a "readily detectable" difference at low illumination levels. In addition Johnson and Casson[10] using a larger simulated range of refractive errors up to 8 dioptres found that the effect of luminance, contrast and blur on visual acuity was additive. A larger effect on visual acuity was found with dioptric blur up to 2 dioptres and a more gradual reduction in visual acuity with dioptric blur over 2 dioptres. The reason for this apparently worse visual acuity result for non-emmetropes in lower illumination levels is unclear. One possibility may be related to accommodation. Jiang, Kenneth, Herschel[16] stated that when luminance is lowered accommodation tends to shift toward different and individually characteristic resting potentials commonly known as dark focus. This position is not a static one and can vary depending on the type of refractive error and is biased towards the last accommodative position. Many of the subjects tested in the current study were university students with a larger than normal near point work load. This may have contributed to a "night myopia" effect which would reduce visual acuity levels in the non-illuminated room. Further research would need to more closely examine this effect.

Although the differences in visual acuity found in the two different illumination levels were small, it remains to be seen whether this effect would be maintained in a different population. All subjects tested were considered to have no ocular abnormalities. What might be the case in a population with ophthalmic abnormalities or with an older population? It is known that patients with age related macular degeneration have difficulty performing acuity tasks at lower luminances[17]. Anisometropic amblyopes also record lower visual acuity levels than strabismic amblyopes at reduced luminance levels.[18] Sturr, Kline and Taub[19] compared the ability of younger (18 to 25 years) and older (60-87 years) subjects to reach the 6/12 acuity level in varying luminances. At lower luminances a much smaller proportion of the older subjects were able to meet the 6/12 acuity standard (required for driving). They suggested that daytime acuity was a poor predictor of low illumination acuity. While all these researchers were evaluating luminance of the chart and not room illumination levels, each can be considered to be influencing the contrast of the visual acuity chart and ultimate visual acuity recorded.

Conclusion

There appears to be small reduction in visual acuity when tested in a non-illuminated room, which is greater (around 3 to 4 letters on a Snellens chart) for subjects with an uncorrected refractive error. Although this may be considered a tolerable error inherent in measuring any psychophysical function, consideration should be given to standardizing such illumination in clinical populations.

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Low Vision Rehabilitation: An Update

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Abstract

The human and financial costs associated with sight loss can be reduced by appropriate low vision rehabilitation strategies. Low vision rehabilitation is an increasing area of work for the orthoptist in Australia. The aim of this project is to establish the range of rehabilitation services being provided by orthoptists in low vision centres in Australia and in particular the rehabilitation technique of eccentric viewing. Information is also sought internationally in relation to the role of the orthoptist in low vision. Data are collected by survey and analysed for trends for comparison with previous studies. Orthoptists working at low vision centres are surveyed to gather information.

Key words:

Sight loss, vision impairment, orthoptist, eccentric viewing.

Sight is a valuable sensory mechanism informing us of the world around us. Australian Bureau of Statistics figures indicate 9% of the Australian population have sight loss and that the incidence of sight loss increases with age.[1] Loss of sight can severely compromise daily functions and reduce independence. A brief review of the literature reveals the extent and nature of this impact. A number of researchers report loss of ability to perform certain household tasks such as shopping, cooking and housekeeping to be associated with sight loss.[2-4] An American study reports older persons with vision impairment are 1.37 times more likely to experience difficulties with activities of daily living.[5] The impact on mobility is reflected in reported difficulty with public transport and walking.[6,7] Loss of mobility also contributes to feelings of isolation which is a commonly reported psychosocial impact of sight loss.[2-4,8-10] In addition, vision impaired individuals are reported to have a higher incidence of falls and are more likely to be injured as a result of falls.[11]

Sight loss also impacts on a person's feelings of well being. Vision impaired participants in Keefe's focus group based study report difficulties in consumer and social interaction due to an inability to recognise faces. Participants in the focus groups also reported difficulties with personal tasks such as self administering medicines, and embarrassment with eating skills when eating in public.[4] A personal difficulty which is often not considered is the loss of confidentiality associated with loss of reading ability and consequent reliance on other people to read personal documents.[4]

The impact of vision loss on the individual has been the subject of a number of studies however the impact on society generally is less well documented. Further study needs to be done on the impact of sight loss on the use of community services such as "meals on wheels" and home help. One German study reports the increasing costs of welfare payments due to vision impairment and the need for rehabilitation to reduce this cost.[12] Vision impairment amongst nursing home residents increases the dependent needs of these residents with a consequent increase in workload and stress on nursing home staff.[13]

As Krumpaszky and co workers suggest, the impact of sight loss on the individual and subsequently the community can be reduced with effective rehabilitation. Age-related macular degeneration (AMD) is a major cause of legal blindness in the aged.[14-16] This eye disease is associated with severe vision loss as a result of damage to the foveal region of the retina.

Consequently AMD has the potential to severely compromise the ability to perform many daily tasks such as reading, driving and ability to recognise faces.[17] These functional losses will result in a loss of independence. The impact on function associated with sight loss caused by AMD can be ameliorated by a technique of vision rehabilitation known as eccentric viewing.[18-21] Other common causes of sight loss include cataract, diabetic retinopathy and glaucoma.[16] The functional impairments associated with these causes of sight loss may be reduced by the appropriate use of optical aids.[22, 23] Appropriate lighting and use of colour contrasts also provide simple but effective means of rehabilitation.[24,25] A range of professionals including occupational therapists, low vision therapists and teachers have provided aspects of vision rehabilitation. However orthoptists have the most appropriate background in anatomy and physiology of the visual system, ocular pathology and the basic therapy skills to best provide vision rehabilitation. Orthoptists in Australia have broadened their field of practice to include low vision rehabilitation and more recently orthoptists in Europe and the UK have followed this trend. The aim of this paper is to present an overview of orthoptic involvement in visual rehabilitation both nationally and internationally and to consider some of the characteristics of low vision rehabilitation in Australia.

Method

Data was collected by questionnaire. One questionnaire was presented to representatives of member countries attending the 1998 International Orthoptic Association Council. This questionnaire consisted of four questions:

1. Do orthoptists work in low vision rehabilitation in your country?

   If the response to this question was yes then the following questions were asked:
2. Do orthoptists receive additional training to provide vision rehabilitation?
3. Does the orthoptist work with optical aids and / or provide rehabilitation therapy?
4. Is vision rehabilitation a developing field for orthoptists in your country?

A second questionnaire was sent to the orthoptist(s) in the major low vision agencies across Australia. There were six agencies for the blind with questionnaires sent to capital city bases in Adelaide, Brisbane, Melbourne (two agencies), Perth and Sydney and four regional branches in Victoria and two in NSW. In addition one questionnaire was sent to a Melbourne private practice which provides vision rehabilitation.

Results

1. Results from the international survey (n = 10)

Orthoptists are working in low vision in the following countries: Austria, Belgium, France, Japan, Netherlands, Portugal, Sweden and UK. They are not doing this work in South Africa and Switzerland.

From the representatives of the eight countries where orthoptists work in low vision the following information was also gained:

Non compulsory additional training is provided in Austria, France, Portugal and Sweden

All countries indicated that the orthoptists role includes optical aids and low vision training strategies

Low vision rehabilitation is a growing field in all of these countries.

A comment of interest was reported from Belgium where legislation requires an agency to employ orthoptists to be recognised as a low vision agency and orthoptists are the only professional group permitted to provide low vision services.

2. Results from the Australian survey. There was an 85% return rate (11 of 13 questionnaires).

Demographic data

Age range of the clients seen by respondents was from 60 to 90 years with the exception of one respondent who saw children, age range 5 to 8 years. The measured distance acuities of clients ranged between 6/18 to 6/240 and in addition one respondent reported clients with sight reduced to hand movements. The range of near acuities reported was from N6 to N96.

Respondents were asked to indicate the type of service provided and the frequency of providing those services. These responses are recorded in Table 1.

Respondents were asked to indicate the frequency with which they provided specific vision rehabilitation training services these responses are recorded in Figure 1.

Respondents who provided eccentric viewing training were asked to indicate the materials used to provide training, the length of time spent in training and the outcome in terms of a near acuity measure. Table 2 indicates the type of training materials used and the number of respondents who used each.

In addition individual respondents reported using the Visual Rehabilitation Resource Books (Fitzmaurice 1993) the Eccentric Viewing Home Kit (Fitzmaurice 1994), school work and "cross" exercises.

Table 3 indicates the number of training sessions provided and the outcome in terms of near acuity.

Some respondents indicated the pre and post training near acuities for each of their clients. This information is presented in Figure 2.

Another potential outcome measure of rehabilitation training is the clients' perceived functional improvement. Respondents were asked to record client comments as to functional improvements in their visual function post training and these comments are recorded in Table 4.

Table 1. Services Provided by Respondents and Frequency of Delivery (n=11).

Task	1	2	3	4
Optical Aids	10	0	0	1
Lighting	10	0	0	1
Training	4	5	1	1
ADL	6	3	1	1
Mobility	2	1	1	7
Education	8	3	0	0
Counselling	6	1	1	3
Visual Fields	4	1	n/a	n/a
Sports Category	0	2	n/a	n/a
CCTV	2	n/a	n/a	n/a
Reading Stands	1	n/a	n/a	n/a
Reading Aids	1	n/a	n/a	n/a
Glare Control	1	n/a	n/a	n/a
WorkPlace Consultancy	n/a	1	n/a	n/a
Work with Children	1	n/a	n/a	n/a

1 = Frequent (weekly)
2 = Sometimes (monthly)
3 = Rarely (occasionally over a year)
4 = Never

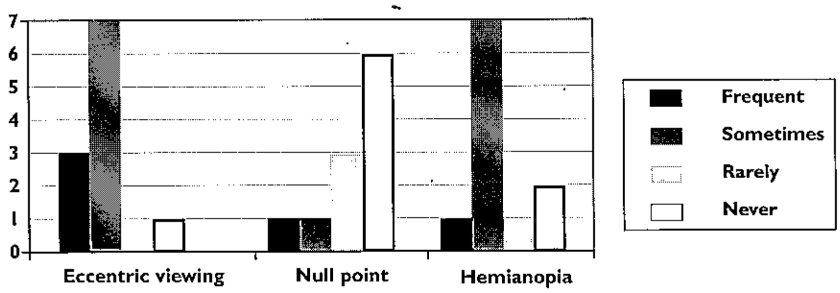

Figure 1. Frequency of Providing Vision Rehabilitation Training Services (n=11).

Table 2. Techniques used to train eccentric viewing (n=7).

Group	Number of Respondents
Large objects	7
Reading Tasks	7
Cards	6
Computer	2

Note: Where respondents indicated the reduction in print size by giving the maximum and minimum point sizes I have calculated improvement at 2 point intervals. If respondents indicated an actual number of points as the reduction of print size this figure is used.

Table 3.
Summary data relating to training sessions.

Number of training sessions	Outcome in nearactuity improvement
3 - 7	4 points (N18 - 10)
2 - 4	1 point
1 - 2	12 points (N40 - 16)
2 - 6 months	2 points
1 - 2	1 - 2 points
1 - 26	Improvement indicated but not quantified
4 - 6	Mean increase 10 points
6 weeks to 6 months	8 to 10 points

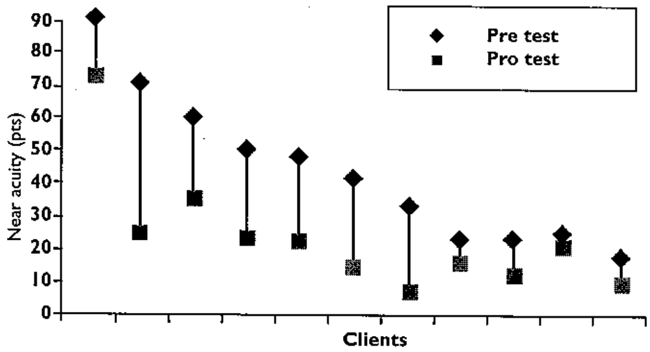

Figure 2.
Reported Near Acuities Pre and Post Eccentric Viewing Training.

Table 4.
Reported Functional Outcomes of Eccentric Viewing Training (n=7).

Improved Function	Number of Respondents
Seeing Faces	6
Reading	5
Watching TV	5
Bowls (lawn or carpet)	3
Assisted in social activity	1

Discussion and Conclusion

Orthoptists working with agencies for low vision across Australia provided a range of services. The most commonly provided services were optical aids (two respondents specified they provided advice/training only, not prescription); lighting, education, activities of daily living and counselling (Table 1). It is interesting to compare these results to those obtained in an unpublished survey conducted by Fitzmaurice and Wulff in 1992 and reported at the OAA Conference of that year (titled: Survey of Orthoptists working in Low Vision within Australia). Whilst the 1992 survey was sent to a larger number of orthoptists it was possible to identify the data from the same major agencies surveyed in the current study. The 1992 data was similar to this study in that optical aids, lighting, activities of daily function (ADL) and education were the most commonly performed tasks. However in the 1992 study orthoptists commonly provided assistance with reading and 50% of respondents provided assistance with writing. These activities were not commonly reported in this study. Provision of eccentric viewing training remains at a similar level from 1992 to 1998, provision of null point training had decreased (5 in 1992 to 2 in 1998) and provision of hemianopia training had marginally increased from 7 to 8 respondents.

To provide the above mentioned services effectively a practitioner would gain benefit from a thorough knowledge of the anatomy and physiology of the visual system. Services associated with optical aids and lighting would be enhanced by a thorough knowledge of optics and an understanding of the properties of light. Provision of rehabilitation therapy, education and counselling would all be enhanced by a knowledge of psychology and sociology. All of these studies are incorporated into the orthoptic training programs in Australia. Thus the trend of Australian orthoptists to move into the low vision industry is well supported by their academic training.

Nine of the eleven respondents were actively involved in providing eccentric viewing training. Two respondents indicated they discussed eccentric viewing with their clients but did not have time to provide training. Eight of the respondents indicated they were involved in training clients with hemianopia (Figure 1). Respondents were further questioned about the eccentric viewing services provided and the client outcomes (Tables 2 - 4 and Figure 2). The commonly used training methods involved print materials of varied size and form (Table 2). Training programs varied in length from 1 or 2 sessions to 6 months. In all cases clients demonstrated a decrease in the print size able to be read post training (Table 3 and Figure 2). In this small sample training method and duration do not appear to influence measured outcome. The only objective outcome measure is pre and post training print size. Whilst the number of clients reported in this study is too small to indicate statistical significance of improved print size, these results show a similar trend to those reported in a larger sample by Fitzmaurice.[26] In this study of 86 clients post training near acuity was found to be significantly better than pre training near acuity ($t = 8.243$ $p = 0.0001$). It is interesting to note that the trend to improved near acuity post eccentric viewing training can be demonstrated by a number of orthoptists providing varied training programs.

A subjective outcome measure is the clients' perceived change in visual function. The responses in this survey support previously reported data that eccentric viewing is an appropriate strategy to ameliorate the disability associated with loss of macula vision.[18,19,21,26] Previous studies indicate some of the functional deficits associated with centre field loss include inability to see faces, difficulty with reading,[4,17] difficulty with daily tasks[2-5,8,9] and social isolation.[2-4,10] The functional improvements reported by clients of survey respondents included seeing faces[6], reading[5] and a range of social activities[9] (Table 4).

The data from this study provides a useful record of the role of the orthoptist in low vision in Australia and the emerging role internationally. The survey provides clinical evidence of the benefits of eccentric viewing as a strategy to ameliorate some of the functional losses associated with sight loss. The literature reflects a growing body of evidence that sight loss is debilitating to the individual and often results in a loss of independence. Loss of independence creates a cost to the individual and in the wider view the community generally through increased demand on community services and nursing home places. It would appear the orthoptist can provide services which will help to ameliorate the impact of sight loss on the individual and it is reasonable to extrapolate that increasing an individual's functional abilities will also result in savings for the community generally. The type of services being provided are closely associated with the areas of study undertaken by undergraduate orthoptists thus suggesting orthoptists are appropriate professionals to provide low vision services. Whilst the data from this study is only indicative of certain trends it suggests more rigorous comparative studies are required to establish the value of low vision rehabilitation in terms of outcome measures and cost benefits. Further, the suitability of the orthoptist to provide these services should be firmly established.

Acknowledgement

My sincere thanks to the orthoptists who gave their time to participate in these surveys.

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Outcomes of Cataract Surgery – What are we Measuring?

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Abstract

As the criteria for assessing the need for cataract surgery is moving away from the clinically based measurement of visual acuity to a subjective assessment of visual impairment by the patient, the same cannot be said for the outcome of cataract surgery. Outcomes are still assessed by complication rates and visual acuity. This paper aims to measure the outcome of cataract surgery using the same criteria that is used to judge the timing of cataract surgery, that is impairment of visual functioning. One hundred patients booked for first eye cataract surgery at the Royal Victorian Eye & Ear Hospital were interviewed using the VF14 questionnaire to assess functional impairment. Visual acuity was taken from the patients' records and patients were asked about their general satisfaction with their vision. Seventy four of these patients were followed post-operatively. Results show 90% of patients had an improvement in visual acuity, 80% had improved visual functioning as measured by the VF14 and 76% were more satisfied with their vision post-operatively. This study shows that the success rate of cataract surgery depends upon the outcome measure being used.

Introduction

Traditionally the outcomes of cataract surgery are measured by the technical success of the surgery or complication rates, and the clinical measure of visual acuity. Although modern cataract surgery is a low risk procedure it is not risk free. Major complications include endophthalmitis, bullous keratopathy, malposition or dislocation of the intraocular lens, clinical cystoid macula oedema, sub-clinical cystoid macula oedema, retinal detachment, wound gape/iris prolapse, anterior chamber haemorrhage, hypopyon, iris trauma, posterior capsule rupture, vitreous loss, vitreous haemorrhage, choroidal haemorrhage, uveitis, raised intraocular pressure and posterior capsule opacification.[1] Powe et al[1] conducted a review of 90 studies published in America between 1979 and 1991 on complication rates following cataract surgery. Although complication rates varied in the different studies, the pooled rate for the serious complication of endophthalmitis was 0.13% rising to 19% for the less serious complication of posterior capsule opacification. The average rate for serious complications was 2%. In the United Kingdom, a study of complication rates of all patients undergoing cataract surgery in 1990 reported results similar to the American study for serious complications.[2] However, technical success of the operation does not necessarily translate into better vision for the patient.

Visual acuity is the other traditional outcome measure of cataract surgery. Powe et al[1] using 6/9 as a successful outcome measure, found 89.7% of eyes achieved this acuity post-operatively. Desai[2] defined a good visual outcome as visual acuity of 6/12 or better and found 80% of patients achieved this result. Defining a good visual outcome as a visual acuity of 6/9 or even 6/12 has limited meaning when in the present study undertaken 34% of eyes listed for surgery had a visual acuity of 6/12 or better. The question is then raised, does the patient have better visual functioning post-operatively? How does the measure of visual acuity equate with a patient's visual symptoms? The limitations of visual acuity as a measure of visual function are well

Table 1.
Distribution of Visual Acuity Pre and Post Operatively.

Visual Acuity	Pre-operative % of Patients N=100	Post-operative % of Patients N=73
6/4	0	12
6/5	0	22
6/6	0	27
6/9	17	27
6/12	17	1
6/18	16	3
6/24	12	1
6/36	16	4
6/60	7	0
less than 6/60	15	1

Table 2.
Distribution of VF14 Scores Pre and Post Operatively.

VF 14	Pre-Op % of Pts N=100	Post-Op % of Pts N=74
0-10	0	0
11-20	2	1
21-30	0	0
31-40	4	0
41-50	10	7
51-60	12	4
61-70	17	5
71-80	19	4
81-90	21	14
91-100	15	65

Table 3.
Distribution of Satisfaction Scores Pre and Post Operatively.

Satisfaction Score	Pre-Operative % of Patients N=100	Post-Op % of Patients N=74
1 (very dissatisfied)	28	9
2 (dissatisfied)	55	15
3 (satisfied)	17	32
4 (very satisfied)	0	41

known. Visual acuity does not necessarily reflect a patient's visual functioning or the symptoms associated with cataract. Indeed it can be difficult to equate a patient's symptoms with the objective measure of visual acuity. Many studies[3-10] have shown correlations between the two to be only in the poor to moderate range. Therefore, from the patient's perspective, an increase in visual acuity on the Snellen chart may not equate with their perception of better vision.

A patient's satisfaction with their surgical outcome will depend upon their ability to function better. As early as 1981, Bernth-Petersen[3] demonstrated that cataract surgery improved a patient's ability to function as well as improving their vision. Questionnaires have been developed to assess this functional status.[8-10] These questionnaires provide a score which gives a level or grade of functional impairment. Impairment of visual functioning is now recognised as the primary indicator for cataract surgery[12] but the outcomes of cataract surgery are still expressed by the clinical measure of visual acuity.

This study aims to investigate the outcomes of cataract surgery at the Royal Victorian Eye & Ear Hospital using the multiple outcome measures of visual acuity, visual functioning and patient satisfaction.

Method

Subjects

This study recruited 100 patients from the outpatients department, Royal Victorian Eye & Ear Hospital. There were 41 males and 59 females ranging in age from 48 years to 91 years with a mean age of 74 years. Subjects were excluded if they had a previous intraocular lens, myopia greater than 5 dioptres, were booked for a simultaneous ocular procedure or did not have enough English skills to complete the questionnaire. Post-operatively, patients were excluded if they had second eye cataract surgery within the 3–4 month follow up period.

Apparatus

The questionnaire chosen to assess impairment of visual functioning was the VF14, an index of Functional Impairment in Patients with Cataract, developed by the Cataract Patient Outcome Research Team[9] in 1994. Questions relate to everyday activities including seeing steps, writing cheques, playing table games, taking part in sports, cooking, reading small print, doing fine handiwork, reading a newspaper or a book, daytime driving, night driving, reading traffic signs, reading large print and recognising people. Subjects were asked to rate the degree of difficulty they had with each activity because of their vision, with 0 being inability to do the activity and 4 no difficulty at all with the activity. A score out of 100 resulted, with 0 being an inability to do any of the activities because of vision and 100 being able to do all of the activities without difficulty. Subjects were also asked about their overall satisfaction with their vision and a Satisfaction Score between 1 and 4 was given, with 1 being very dissatisfied with vision and 4 very satisfied with vision. Visual acuity was measured on the Snellen chart, a standard instrument used in the clinical setting.

Procedure

Patients attending clinics for their pre-operative assessment were invited to participate. Informed consent was obtained and the patient was interviewed. Interviews took up to ten minutes to complete. The most recent recording of Snellen visual acuity using the patient's current glasses was taken from the medical records. Three to four months post-operatively the same patients were mailed the VF14 questionnaire and invited to complete and return it. Of the 100 patients booked for surgery, 10 patients cancelled the operation and 12 had bilateral cataract surgery within 3 - 4 months and so were excluded. Of the remaining 78 patients who were sent post-operative questionnaires, 4 did not return the questionnaire. This left 74 patients remaining in the post-operative group. One patient was followed up elsewhere, and although her visual acuity results were unavailable, did participate in the VF14.

Results

Pre-operatively visual acuity ranged from 6/9 to Perception of Light with a median acuity of 6/24 (Table 1). The pre-operative VF14 scores ranged from 13 to 100 with a mean of 72 (Table 2). The Satisfaction Scores are shown in Table 3.

Of the 74 patients remaining in the study 92% (68 patients) had surgery by phacoemulsification while the remainder had extracapsular cataract extraction. All had posterior chamber intraocular lenses inserted. The complication rate was seven patients (9.5%).

Post-operatively visual acuity ranged from 6/4 to 6/120 with a median acuity of 6/6 (Table 1). The VF14 scores ranged from 11 to 100 with a mean of 87 (Table 2). The Satisfaction Scores are shown in Table 3.

Using visual acuity as an outcome measure 90% (67 patients) improved. Using the VF14 as an outcome measure 80% (59 patients) improved, and using Satisfaction Scores, this figure was 76% (56 patients). A distribution of change in each of these measures are shown in Figures 1, 2 and 3 where change is calculated by subtracting the pre-operative score from the post-operative score, where visual acuity was converted into a scale of 1-10 as per line of visual acuity. A positive score indicates improvement whereas a negative score indicates a decrease in measure. Looking at multiple outcome

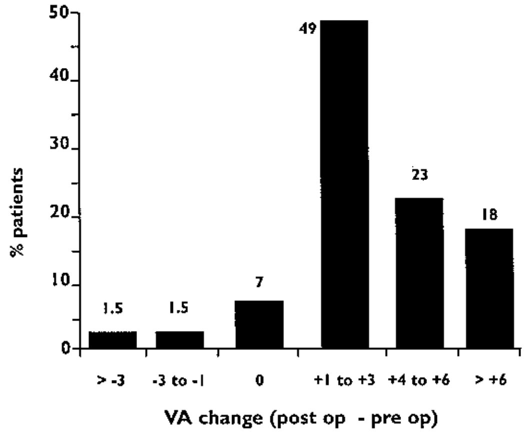

Figure 1.
Distribution of change in VA scores post operatively.

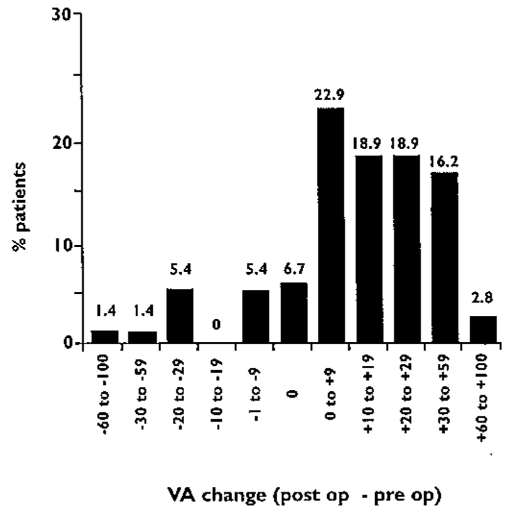

Figure 2.
Distribution of change in VF14 scores post operatively.

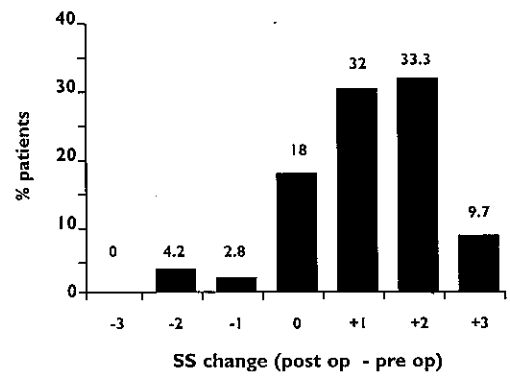

Figure 3.
Distribution of change in satisfaction scores post operatively.

measures, 64% (46 patients) improved on all three measures, 18% (13 patients) improved on two measures, 14% (10 patients) improved on one measure only. Two patients (3%) did not improve on any measure at all.

Discussion

Several studies have demonstrated that cataract surgery improves the visual functioning of elderly people, resulting in an improvement in their overall quality of life.[13,14,15] This involves not only visual functions but mental status and manual performance. Brenner[15] indicated that this function only improves when cataract surgery results in a significant improvement in visual acuity. Any meaningful definition of the success of cataract surgery should include, not only visual acuity, but the patient's perceptions of improvement in visual functioning. Measures that emphasise the patient's perception of health are now increasingly recognised as important indicators to evaluate the effectiveness of surgical intervention. This study showed 90% of patients improved on the clinical measure of visual acuity, while only 80% had improved visual functioning, so it can be seen that patients may have an improvement in visual acuity without an improvement in visual functioning or satisfaction with vision, a similar result to that shown by others. Steinberg et al[16] found a 96% improvement in visual acuity, an 89% improvement in visual functioning using the VF14 and an 85% improvement in patient satisfaction. Mangione et al[14] showed a 95% improvement in visual acuity and an 80% improvement in visual functioning as measured by the Activities of Daily Vision Scale. Schein et al[17] found a 96% improvement in visual acuity and a 92% improvement in visual functioning using the VF14. These results show visual acuity may not be a particularly valid measure of success if the patient does not perceive any improvement.

Only 64% of patients improved on all three outcome measures, when it may be presumed that patients have a reasonable expectation to improve on all outcome measures. Indeed, a study by Tielsch et al[18] showed that patients have very high expectations of surgery. Failure to improve on any outcome measures has been linked to increasing preoperative age, minimal preoperative functional impairment, minimal symptoms associated with cataract and ocular co-morbidity.[17]

This current study showed 20% of patients reported either no improvement or a reduction in VF14 scores. This and other studies[14,15,16] have defined improvement in visual functioning as any increase in VF14 scores, however a small increase in score may not translate into any meaningful improvement for the patient. This present study showed 23% of patients had a change of only 1-9 points on the VF14. If the criteria for success is changed to exclude these small figures, the success rate drops to 57%. However, a patient satisfaction level of 76% as measured by the increase in Satisfaction Score suggests that perhaps an improvement in only one function of daily living is significant to the patient or, patients may be satisfied with a dimension not measured by the VF14. The VF14 questionnaire, although questioning many aspects of visual functioning may not detect all the symptoms associated with cataract as there are no specific questions on glare, distorted vision or loss of colour.

Conclusion

Cataract surgery is now the most common surgical procedure performed under Medicare with the number of operations more than doubling in the 10 year period between 1985 and 1994.[19] As health costs soar, governments as well as patients are becoming interested in the outcomes of expensive, high volume surgery. The success rates of cataract surgery depend upon the outcome measure being used. The very high level of success rates expressed when using visual acuity or complication rates as outcome measures may not necessarily reflect a change in quality of life for the patient and therefore may not be the most appropriate measure as determined by the patient. Patients' perception of their health and visual status are perhaps more valid outcome measures than the clinical measure of visual acuity.

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School Screening – Referral Criteria & Incidence of Ocular Disorders in the Blacktown Local Government Area of Western Sydney

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Abstract

Students at kindergarten and Year 5 (n=3,289) underwent primary or secondary vision screening by the Community Orthoptist as part of the community health program for the Blacktown local government area during 1996 and 1997. This paper documents the visual screening standards used and the incidence of referral. The statistics demonstrate the need for school screening to continue and the importance of screening Year 5 as well as Kindergarten children with a total referral rate of 20.6%. Visual acuity accounted for 16.7% of this total, and ocular muscle defects rated at 3.9%.

Key words:

Vision screening standards, Kindergarten, Year 5, visual acuity, ocular muscle defects

Introduction

The necessity for visual screening of primary school age children is universally acknowledged and accepted.

The purpose of this study is to document the referral criteria used in school screening in the Western Sydney Area Health Service of children in Kindergarten and Year 5 who are initially screened by generalist community nurses.

A further purpose is to report the statistical incidence of ocular disorders occurring in the Blacktown local government area for school students in both Kindergarten and Year 5.

National Health & Medical Research Council Rationale

The National Health and Medical Research Council (NH&MRC) acknowledges the usefulness of vision screening projects for detecting ocular disorders in children.[1]

The NH&MRC have outlined the rationale for screening children at various stages of development including those of school age.

The NH&MRC and the Orthoptic Association of Australia, NSW Branch (OAA NSW)[2] recommend screening children in Kindergarten with the aim of detecting strabismus and refractive errors which both have potential to cause amblyopia. Vision screening of this age is performed virtually universally. It is therefore the role of school screening to identify any ocular problems that will interfere with children's abilities to perform at their best in school. However, the subject of whether to continue school screening has been open for discussion for some time by the various health areas and especially in regard to students in Year 5.

Visual screening of students in Year 5 is not primarily concerned with the detection of any strabismic or amblyopic defects although sometimes these are detected. Rather, screening is aimed at detecting reduced vision due to refractive errors as well as reduced convergence, both of which may lead to reading problems and poor concentration with close work. Subtle or developing symptoms can also be detected by early screening.

Myopic errors may have greater consequences in early adolescence due to the increasing academic demands on students. Repeating earlier screening is therefore useful in order to identify those students with developing or increased symptoms other than those previously detected.

If screening is not carried out in Year 5 there is an increased reliance on the children, parents and teachers to determine if a visual problem exists and whether or not this is the cause of poor classroom performance.

The NH&MRC has noted[3] that international studies indicated the usefulness of far more comprehensive programmes than those that appear to be generally employed in Australia.

Review of the literature illustrates the importance of school screening. Abolfotouh MA et al, [4] conducted a study in which 971 schoolboys were screened on a random selection process and 1.85% were found to have amblyopia due to refraction or strabismus where visual acuity was worse than 6/9 with no structural disease of the eye. Auzemery A, et al,[5] reported that 1081 children from 8-14 years were screened of which 4.7% were diagnosed with defects 2% refractive; 1.4% amblyopia either refractive or strabismic; 0.74% strabismis without amblyopia; and, 0.57% medical pathology, Brown S, Jones D,[6] showed 5430 kindergarten children were screened and determined 6/6 to be the normal level of visual acuity in the Sydney Metropolitan Area. McKenzie L,[7] reported that 638 children were screened and 8.3% were found to have previously undetected defects. Preslan M W, Novak A,[8] screened 680 primary aged children with findings of amblyopia 3.9%, strabismus 3.1%, and refractive error 8.2%. Rodrigues M A, Castro Gonzalez M,[9] selected a sample of 17,697 records. The results showed 48% had refractive defects and 1.2% amblyopia associated with greater refractive errors.

At present, Western Sydney Area Health Service generalist community nurses of Blacktown, Doonside and Mount Druitt are continuing to screen both age groups.

Therefore, Year 5 students need at least visual acuity and the convergence near point to be tested. These are the same tests noted in an unpublished study on Year Nine students (approximately 14 years of age) who found that such students had the largest proportion of defects in these areas.[10] The Orthoptic Association of Australia (OAA NSW) recommends screening of children aged 10 to 12 years.[11]

The Role of the Orthoptist in School Screening

The OAA NSW states that the role of the Orthoptist is to perform secondary screening.[12] That is, once nurses have completed primary screening of all the children, those for whom there are concerns should be seen by an Orthoptist. The role of the Orthoptist is then to decide if each child's visual condition needs to be, in their professional judgement, referred or reviewed according to the established criteria.

The NH&MRC notes that Orthoptists are most effectively used when involved in secondary screening.[13]

The Orthoptist should carry out the appropriate action for each child concerned including liaising with parents and teachers. Other roles of the Orthoptist in the context of a community health setting include the education of parents, teachers and nurses by conducting inservice programmes on various subjects.

The aims of the established and published referral criteria are to aid in the early detection and therefore primary intervention of amblyopia or strabismus. This leads to treatment that gives the best achievable health outcomes - visual acuity and binocular functions - for the children involved.

Western Sydney Area Health Service (WSAHS) Visual Screening Standards

The Western Sydney Area Health Service (WSAHS) requires that a set of visual screening examinations be performed on specified students by nurses and orthoptists. Within the Blacktown local government area Generalist Community Nursing Teams (GCNTs) routinely screen vision for all Kindergarten and Year 5 children plus all new enrolments.

The standard visual screening tests performed are as follows:

Kindergarten (children of approximately 5 years of age) and new enrolments:

- Vision testing (distance only)
- Strabismus testing (near and distance, manifest and latent) using the cover test method
- Corneal reflections
- Ocular movements
- Convergence

Year 5 (children of approximately 10 years of age):

- Vision testing (distance only)
- Convergence

Near vision of year 5 students is tested only in cases of reduced convergence or upon request of a parent or teacher.

From the results of these tests nurses and orthoptists are expected to apply the following criteria in each case of potential review or referral as noted in the WSAHS Community Health School Screening Manual updated by the author in 1996.[14] A summary of these standards is provided in Figure 1.

Figure 1.
Summary of Western Sydney Area Health Service Visual Screening Standards.

Reason for Review or Referral	Criteria Applied
Vision - referral	under seven years of age with a visual acuity (VA) of 6/9 or less in one or both eyes
	over seven years of age with a VA of less than 6/6 in one or both eyes
	when there is a difference in VA between each eye of one or more lines
	nystagmus with binocular vision of 6/12 or less
	with glasses that have not been checked for more than 12 months
Vision - review within 12 months	5 years of age with 6/9 in one or both eyes
	permanently amblyopic in one eye (to ensure that the vision in the good eye does not deteriorate)
Strabismus - referral	with a manifest strabismus
	with a large latent strabismus
Ocular Movements - referral	whose eye movements are not symmetrical
Convergence	no action if 5 centimetres or better
	review within 12 months if between 5 and 10 centimetres and asymptomatic
	refer if convergence greater than 10 centimetres
Pathology referral	any pathology of external structures noted during eye examination

Results

School screening statistics were collated from the five local government areas within the Western Sydney Area Health Service (WSAHS) during 1996 and this was the third year that such records were maintained within:

Auburn
Blacktown
Baulkham Hills
Holroyd
Parramatta

During 1995 the nurses' screening results for Year 5 students within the Blacktown local government area recorded defects of 7.75%.

Shown in Figures 2a and 2b are the Blacktown local government area generalist community nurses' statistics for 1996. The classifications employ the criteria previously shown. (Where "No Further Action" is shown this is when results are normal or the child is already under the care of a specialist).

Figure 2a.
Findings of Blacktown local government area generalist community nurses visual screening in 1996.

Screening Findings	Kindergarten	Year 5	Total
Total Screened	3,832 (100.0%)	2,514 (100.0%)	6,346 (100.0%)
New Defects	265 (6.9%)	220 (8.8%)	485 (7.6%)
Known Defects Reviewed	40 (1.0%)	56 (2.2%)	96 (1.5%)

Figure 2b.
Outcomes of Blacktown local government area generalist community nurses visual screening in 1996.

Screening Outcomes	Kindergarten	Year 5	Total
No Further Action	3,378 (88.2%)	2,213 (88.0%)	5,591 (88.1%)
Referred to Orthoptist	454 (11.8%)	301 (12.0%)	755 (11.9%)

As can be seen the incidence of new defects was significant among students in Kindergarten. Interestingly, the level of new defects in Year 5 students was even greater although this is a group of children for whom universal screening is somewhat more controversial.

Overall, almost one in every eight students assessed by nurses was referred to the Orthoptist for review.

The outcomes of students referred to the Orthoptist, plus those students seen by the Orthoptist in the course of primary screening during 1996 and 1997 appear in Figures 3 and 4 respectively. The reviews and referrals recorded as being for Visual Acuity relate to vision being 6/9 or less, whilst the Ocular Muscular Defects relate to strabismus (constant or intermittent) reduced convergence near-point and ocular movement syndromes.

Screening Outcomes	Total: Kindergarten & Year 5
Total Screened (Referrals + Others)	1882 (100.0%)
No Further Actions	1310 (69.6%)
Reviews - Visual Acuity	154 (8.2%)
Reviews - Ocular Muscular Defects	35 (1.9%)
Total Reviews	**189 (10.0%)**
Referrals - Visual Acuity	326 (17.3%)
Referrals - Ocular Muscular Defects	57 (3.0%)
Total Referrals	**383 (20.4%)**

Figure 3. Outcomes of Orthoptist's visual screening in 1996.

Screening Outcomes	Kindergarten	Year 5	Total
Total Screened (Referrals + Others)	782 (100%)	625 (100%)	1,407 (100%)
No Further Actions	528 (67.5%)	424 (67.8%)	952 (67.7%)
Reviews - Visual Acuity	82 (10.5%)	18 (2.9%)	100 (7.1%)
Reviews - Ocular Muscular Defects	15 (1.9%)	47 (7.5%)	62 (4.4%)
Total Reviews	**97 (12.4%)**	**65 (10.4%)**	**162 (11.5%)**
Referrals - Visual Acuity	131 (16.8%)	92 (14.7%)	223 (15.9%)
Referrals - Ocular Muscular Defects	26 (3.3%)	44 (7.0%)	70 (5.0%)
Total Referrals	**157 (20.1%)**	**136 (21.8%)**	**293 (20.8%)**

Figure 4. Outcomes of Orthoptist's visual screening in 1997.

Of the students initially screened by or referred to the Orthoptist in the figures shown, more than 20% were, on the basis of the established criteria, referred on for specialist assessment. Of this group an average of 16.7% over the two years were referred as a result of their visual acuity.

It can be seen that the total referral rate for defects was consistent over the two years at 20.6%. Reviewing this overall trend against the figures split by student year in 1997 it is notable that the referral rate for students in Year 5 is slightly higher than average at 21.8%.

A further 10.7% of those screened by the Orthoptist were noted for review in 12 months and 72.4% of these were as a result of their visual acuity. Also significant was that in 1997 it can be seen that kindergarten students accounted for 66% of all reviews and referrals due to visual acuity.

Conversely, students in Year 5 comprise 68.9% of those reviewed or referred as a result of ocular muscular defects.

Conclusion

It is evident from the statistical data presented that the overall new defects detected in children in Kindergarten and Year 5 and the referral rate of the Orthoptist demonstrate the adequacy of and need for the existing review and referral criteria employed within the Blacktown local government area.

These conclusions are supported by recent literature which finds that the incidence of defects in school age children is up to 48% in some populations. By far the major category of ocular defects is visual acuity which in this study accounted for approximately 80%.

Most importantly the finding of a significant level of new defects in children in Year 5 indicates that this age group should not be neglected in relation to visual screening. This also highlights the need for school screening criteria to be standardised on a national basis in order to achieve the best long term national health outcomes.

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Corporate Vision Screening

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Abstract

The Cumberland Health and Research Centre is a commercial arm of the Faculty of Health Sciences, University of Sydney, and had requested the School of Applied Vision Sciences, to conduct vision screening of employees at CSR Bradford at Ingleburn in NSW. The employees fell into two work groups, office based staff, who were predominantly computer operators, and operator / fork lift drivers, who were predominantly involved in the factory operation. Vision screening programs were tailored to suit the work requirements of these employees.

Screening was performed on 114 employees and individual written reports were supplied to the company along with a corporate report, summarising the findings of the vision screening and providing recommendations in relation to vision and the workplace arising from the screening program.

A summary of results is presented with a recommendation that orthoptists accept this challenge to be involved in corporate vision screening whenever possible.

Key words:

Corporate vision screening, vision screening in industry, Cumberland Health and Research, Occupational Health and Safety.

Introduction

Occupational health, safety and rehabilitation has become an agenda item at every board room table due to an increased awareness of the cost of injury and an organisation's legal responsibility.

Corporate health programs are designed to keep organisations healthy and productive. This is where an organisation like Cumberland Health and Research provides health management programs and workplace education so that people can effectively manage their health and wellbeing. In this way, both employees and organisations are encouraged to reach their potential in taking responsibility for preventing health problems.

Cumberland Health and Research Centre is a commercial arm of the Faculty of Health Sciences, University of Sydney. One of the Centre's primary objectives is to coordinate and utilise the knowledge, expertise, resources and research facilities of the University, to work with and for their clients, hence providing a comprehensive range of quality health services to them. Cumberland Health and Research Centre is Australia's leading national centre for corporate health, occupational health and rehabilitation, sports medicine, exercise science and rehabilitation programs.[1] The team approach is important to the service Cumberland Health and Research provides, by clients not needing to visit several places for different tests, other opinions or further care, hence maximising effectivity.

Some services offered by Cumberland Health and Research Centre for companies are Health and Management Profiles and Corporate Health Audits, where the auditor, such as the testing of vision and hearing every two years stipulates recommendations.

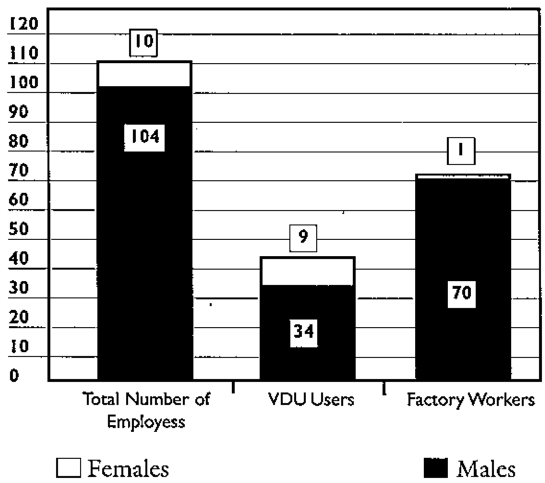
Strang[2] in 1945 discussed Orthoptics in Industry and concluded that Orthoptics and or an Orthoptic department can be considerably helpful to the industrial worker, especially those with heterophoria. This study did find that a considerable number of heterophoria cases required and could benefit from orthoptic treatment.

Occupational health and safety is an issue for any organisation due to the strategic development of Occupational Health and Safety legislation. By law, every employer must provide a healthy and safe workplace, which is also owed personally to each employee. For example, there is a general obligation to provide goggles if there is a likelihood of eye injury, but there is an even greater obligation to protect an employee who has only one eye.[3]

In April 1992, The National Occupational Health and Safety Commission, Work Safe Australia, issued in particular a Technical Report of the study group on eyesight testing of users of screen based equipment,[4] where the need and justification for eyesight testing for users of screen based equipment was documented. Silver and Daniel[5] looked at vision assessment for display screen users and Good, Weaver and Augsburger[6] state that job related vision standards do benefit both employee and employer, and hence devised in their study a model for the application of visual standards to the work place for 40 job classifications. Desai et al[7] also recommended visual screening of industrial workers prior to job placement.

Over the past two years, Cumberland Health and Research has been involved in a variety of vision projects within industry. Vision screening and assessment has been done for companies and industries such as the NSW Bush Fire Brigades, Merck, Sharp and Dohme, BTR Engineering, Telstra, Australian Archives and this year, CSR Bradford is added to the above list.

Figure 1.
Types of employees



CSR Bradford is a company that has been in operation since 1990 at Ingleburn in the South Western Sydney area, and has been a client of Cumberland Health and Research Centre since approximately 1991. CSR Bradford has an Employee Health Monitoring System where recommendation has been made that employee vision is to be tested every two years.

Due to the fact that every organisation is obligated to provide a safe and healthy working environment for their employees, many companies undergo corporate health audits, and it is from this that recommendation for screening is generated. Something such as corporate vision screening does have its place in the scheme of Orthoptic employment, and this particular example of corporate vision screening done at CSR Bradford at Ingleburn NSW, is to increase awareness of this type of involvement orthoptists can have when there is the opportunity to do so.

Method

The vision screening done at CSR Bradford was carried out in the workplace by two Orthoptists in four days, over a period of five weeks (May / June 1998). The vision screening program was tailored to suit the work requirements of the two main groups of employees, office based staff and operators / fork lift drivers.

The screening program for CSR Bradford (Vision Screening Protocol[8]) was prepared by Corporate Health Services at Cumberland Health and Research Centre, University of Sydney, and aimed at detecting the following for each individual employee.

- Need for person to wear glasses or have existing glasses reviewed, but not to provide a prescription for glasses
- Presence of vision which is below the accepted normal adult standard, and may affect work performance in certain circumstances
- Presence of defective eye coordination
- Presence of an eye muscle weakness which may result in double vision or poor coordination when looking in a particular direction
- Inability of the eyes to maintain accurate alignment during prolonged periods of close work
- Inadequate focussing ability of the eyes which would affect prolonged close work
- Reduction in depth perception
- Congenital colour vision abnormalities
- Binocular vision.

Between the two employee groups, 114 employees were screened (Figure 1).

Forty three (38%) of employees tested fell into the group of office based staff, (VDU users), who predominantly used computers for many hours of the day (average hours/day = 5). The age of office based staff ranged from 22 - 63 years (mean age = 38.8 years).

Seventy one (62%) of the employees tested fell into the group of operator / fork lift drivers, (factory workers), who were predominantly involved in the factory operation. The age of this group ranged from 21 - 61 years (mean age = 35.8 years).

Each group's testing procedure differed slightly from the other, (Table 1).

Employee Group	VA 1/3m & 6m	CTN	CTD	CNP (RAF)	OM	BSV (Titmus)	PFR	Accommodation	Saccades/Pursuits	Colour Vision
Office Based Staff	•	•	•	•	•	•	•	•		•
Operator/ Fork lift Driver	•	•	•	•	•	•	•		•	•

Table 1.
Tests performed on two employee groups

Vision was tested at both 1/3m and 6m, and with glasses if the employee currently wore glasses. If vision was less than 6/6, then the pin hole test was done at 6m. Cover testing near and distance was also done with their distance correction. Convergence was assessed by using the RAF Rule and measured at the point of when double was appreciated. If no diplopia was noted, measurement was at the point at which the Orthoptist noted that the eyes were no longer binocular. Diplopia recognition was always questioned.

Stereopsis was evaluated by using the Titmus Fly test and in some cases if this test was inconclusive, the Langs I card was used. Prism Fusion range was done for both work groups and these were tested at 1/3m using prism bars and an accommodative target. Ocular movements were assessed for each group, but for the Operator / fork lift drivers group, horizontal and vertical saccades, distance to near - near to distance adjustments and smooth pursuit were also evaluated. The Office based staff group alone also had their accommodation assessed to the first point of blur. The right eye, left eye, and both eyes open were measured three times each for an average to be taken and to see if fatigue was a factor.

All employees were questioned as to whether they had any eye and visual complaints, signs or symptoms. It was also asked as to when their last eye examination was, especially if glasses or contact lenses were worn, or if a specific problem arose or was observed by the Orthoptist whilst testing such as pterygia, eye irritation, redness or infection.

A written report on each employee screened, including advice where appropriate for further assessment or treatment was forwarded to CSR Bradford. A corporate report was also developed for CSR Bradford, summarising the findings of the vision screening. Recommendations were provided in relation to vision and the workplace arising from the screening program.

Results

Referrals stemming from the corporate vision screening performed at CSR Bradford are summarised in the following graph (Figure 2).

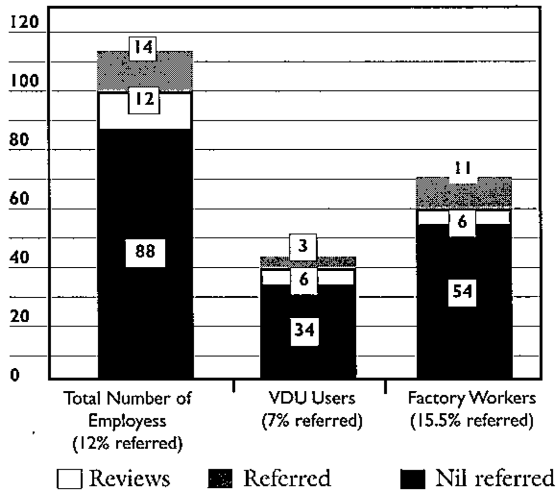


Figure 2.
Referral rates and types of employees

Referral procedure was based on whether there was:

- reduced vision for near or distance
- apparent signs and symptoms of eye strain along with poor binocular vision functions
- a long standing visual problem needing review or a condition not already under care of an eye health professional.

Discussion with the employee in regards to being aware that review or referral may be necessary if signs and symptoms occur in the future and review of glasses on a two yearly basis for those with glasses was recommended.

It was noted that overall, 50 of the 114, (44%) of employees screened wore glasses at a full time or part time capacity. Comparing the two groups, there were a greater percentage of VDU users, (58%), who wore glasses compared to the factory workers, (35%).

Late last year, vision screening done by Wozniak and Wilcox[9] at the Australian Archives on 47 office based staff, found that over 50%, 33 out of 47 participants were wearing glasses in a full time or part time capacity. This may possibly be due to small, previously uncorrected refractive errors being uncovered by the daily use of computers, as working with screen based equipment is most certainly a visually demanding task.[10]

In the 12% of participants that were referred, the main reason of referral was due to reduced near or distances vision in 12 participants. Another two employees were referred for a problem with near work caused by an ocular muscle imbalance and one for recently diagnosed diabetes with a history of fluctuating vision when diagnosed six weeks prior to the vision screening at CSR Bradford.

For another 12 participants, review in twelve months or two years was suggested as these were employees that had signs of potentially having problems with near work in the future due to borderline readings on tests for ocular muscle balance and binocularity. These employees for review did not suffer from any symptoms and had no complaints regarding their eyes. Hanne and Brewitt[11] found a significant difference in asthenopia and daily hours of Video Display Terminals (VDTs) work between VDT workers working less than six hours daily and those working more than six hours daily. It was also noted that their investigation of monocular VDT workers, no visual problem was found. As part of our recommendations, methods of trying to prevent potential asthenopic symptoms from developing were suggested such as:

- the need for frequent breaks from intensive near work and the need to relax the eyes,
- the appropriateness of the participantís current glasses for their present work position
- reinforced the need to have regular two yearly check ups of glasses and employees made aware of the necessity for further ocular examination if current problems increased or if signs, symptoms and concerns arose.

Recommended review in two years was mainly for employees who wore glasses and were currently happy with their present spectacle prescription.

Jackson et al[12] stated that workers involved in uninterrupted display screen equipment (DSE) work for prolonged periods reported visual symptoms twice as frequently as those who spent less time working with DSE. This is therefore showing the need to recommend review and to give general advice regarding ocular posture required for comfortable use of screen based equipment.

Other findings were that nine participants were found to have a red - green colour vision deficiency including one female, though the percentage of males with red - green colour deficiency was 7.7%, which is closely consistent with what literature documents as approximately 8% of the male population.[13,14]

Overall, 15/114 (13.2%) of employees at CSR Bradford had a convergence near point of 10cm or more. Convergence near point results showed that just over 50% (22/43) of VDU users had a near point of 6cm or less. The majority of VDU users (95%) had a convergence near point of 10cm or less. The majority of participants with a convergence near point of 10cm or more (11.6%), also showed below normal base out fusional amplitudes at near, where the normal prism fusional amplitudes used were taken from Mein and Trimble.[14] Stereopsis results for these people were predominantly 40 seconds of arc. It was noted that 24/43 (55.8%) of the office based staff had prism fusion ranges below the normal fusion amplitudes at near compared to 41/71 (57.7%) of the factory workers.

The employees that showed slightly defective accommodation for their age values were predominantly those with below normal fusional amplitudes, yet their stereopsis results were no less than 50 seconds of arc. It was interesting to see that for those who spent 8 hours or more on computers per day tended to have poorer fusional amplitudes, and those who spent no more than 2 - 3 hours doing computer work per day were the majority of those with slightly defective measures of accommodation. Cornell and Heard[15] concluded that measures of accommodation over the age of 50 are moderately and consistently better than those previously published in literature. This is also seen in the office based staff group at CSR Bradford on whom accommodation was measured.

Convergence near point results showed that 41/71 (57.7%) of operator / fork lift drivers had a near point of 6cm or less. The employees in this group that presented with convergence near point of 10cm or more (10/71, 14%) also had below normal prism fusional amplitudes at near. In this group, instead of accommodation being measured, ocular movements were looked into with more detail due to the different nature of their work to the office based staff group. Table 2 shows results from performing ocular movements for the whole group of employees and as two separate groups.

As previously mentioned, Strang[2] deduced that a considerable number of heterophoria cases could benefit from orthoptic treatment. Wozniak and Wilcox[9] may have also found that heterophoria was present and that 13% of participants screened at the Australian Archives suffered from problems with near work that was caused by ocular muscle imbalances.

Campbell and Mein[16] found in a study titled "Civilian Heterophoria" that 75% of subjects complained of headaches, chiefly frontal, which mostly occurred after close work. Others suffered from eyestrain, blurred vision or diplopia on close work.

Findings	Total number of employees	VDU Users	Factory Workers
V Exo pattern	4		4
V Eso pattern	1		1
A Exo pattern	1		1
End point nystagmus	4	1	3
Inferior Oblique O/A	1		1
Unsmooth Pursuit	4	1	3
Saccadic Undershoot	7		7
Saccadic Overshoot	1		1
Distance-near problem	2		2
Duanes	1		1

Table 2.
Ocular Motility

The majority of subjects attributed their symptoms to bad illumination and long hours at work. Upon analysis of occupations, many had to use finely graded instruments and prolonged close work was the most important factor generating the above symptoms.

Overall in vision screening CSR Bradford, the following graph (Figure 3) shows the prevalence of heterophoria and squint in the 114 employees screened. Table 3 shows the two groups separately at CSR Bradford. Figure 3 shows the overall prevalence of heterophoria and strabismus.

In an article looking at a particular computer user with visual fatigue, Irving and Woo[17] stated that it is recommended that attention be paid to the muscle balance and binocular function especially if low plus lenses are to be prescribed for computer use. This is also supported by another study (Dain

	VDU Users (n= 43)	Factory Workers(n= 71)
Orthophoria	32 (74.4%)	50 (70.4%)
Exophoria (Near)	1 (2.3%)	5 (7.4%)
Exophoria (Distance)	11 (25.6%)	14 (19.7%)
Esophoria (Near)	-	-
Esophoria (Distance)	-	2 (2.8%)
Esotropia (Constant)	-	1 (1.4%)
Exotropia (Constant)	-	1 (1.4%)
Exotropia (Intermittent)	-	1 (1.4%)

Table 3.
Prevalence of heterophoria and strabismus.

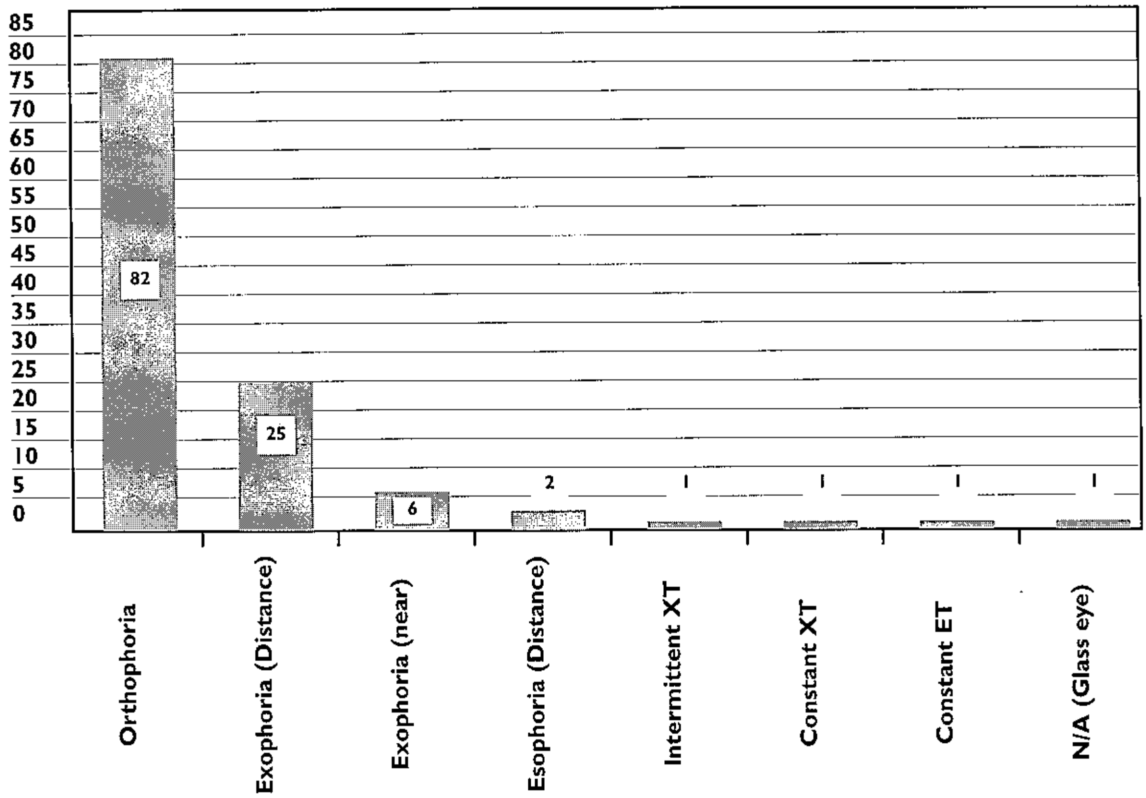


Figure 3. Prevalence of heterophoria and strabismus.

et al) mentioned by Irving and Woo, where it was found that there was a statistical significant relation between heterophoria and symptomatic computer users. Insignificant deviation may become a problem with the increase in near work associated with computers, and the case presented by Irving and Woo shows that positive fusional vergence can be increased and symptoms relieved with orthoptic training.

Lastly, a list of conditions found upon screening is listed in Table 4 below.

Table 4. Miscellaneous conditions.

Condition	Number
Contact lens wearer	4
Borderline asthenopic symptoms	6
Retinal embolism	1
Eye injury	2
Glare sensitivity	2
Pterygia	3
Eye irritation / infection	3
Welders flash	1
Lid lesion	1
Diabetes	1
Duanes	1
Prosthetic eye	1

Discussion

First of all, it is imperative to note the importance of setting standards, especially in such a role like this where occupational health and safety is being dealt with. Along with occupational health and safety goes education and awareness. If certain signs and symptoms are potentially a hazard in the future, it is essential that the person being assessed is advised or made aware that secondary assessment is necessary at the time that problems occur.

Overall, there are many trends with particular results, but many of these trends do have their inconsistencies. Initially this overview on corporate vision screening was not set out to become a statistical piece of research which now has limited me in executing statistical analyses, yet rather just talk about the findings in this particular number of subjects.

The inconsistencies encountered were the uneven numbers between the groups of office based staff and Operator / fork lift drivers and there was also a vast majority of males to females. Test understanding by employees varied throughout testing, and the fact that there were two orthoptists doing the screening, meant that techniques and results may not have been as consistent as if there was only one screener. When comparing differences or similarities between groups, all of the above needs to be kept in mind.

It was interesting to see the trends in relation to asthenopic symptoms. Borderline asthenopic complaints and ocular complaints in general predominantly stemmed from the office based staff group, despite the larger group of operator / fork lift drivers that also had a significant amount of poor convergence and fusional ranges. Sore eyes towards the end of the day was a common complaint, though there were no complaints of diplopia or watery, sore, red eyes whilst doing close work at any time. This then probably isolates soreness at the end of the day as a fatigue factor, due to computer screen glare or decreased blink rate.

It seemed that the fewer the hours one worked on a computer, (half the hours of a working day compared to 6-8 hours a day), prism fusion ranges and convergence near points were slightly reduced. Decreased prism fusion ranges were not only found amongst office based staff, which then raises the question to whether computers or excessive near work helps fusional reserves and convergence near points, or whether it is a detriment to them. There was a larger percentage of factory workers with decreased prism fusion ranges compared to VDU users, but that may purely be due to sample size.

Eyestrain linked with computer work may aggravate fusional and convergence mechanisms hence causing them to be reduced. On the other hand, by having to use the two mechanisms constantly throughout the day, could the fact that they do a lot of close work actually be exercising their positive fusional amplitudes and convergence? This then could be noted that the lack of close work done by the factory workers could possibly be a reason for their fusion ranges and convergence being reduced. It is in the latter group that employees with very poor convergence results were found, yet with no complaints of asthenopic symptoms.

Could a reason for no sign of asthenopic symptoms amongst factory workers then be due to them not having to use computers as part of their job which aggravate decreased mechanisms of fusion and convergence?

More VDU users wore glasses hence signifying that computers aggravate a minimal or borderline need for spectacles and it was also noted that other ocular conditions such as pterygia, glare sensitivity and squint were seen in the non-office based staff.

Trends in a task such as a literature search showed that much research has been done on many other forms of vision screening such as school screening, screening for diabetes, glaucoma, ROP and in the aged, but in comparison, a minimal amount related to screening in industry.

Conclusion

In conclusion then, it is obvious that corporate / industry screening is very much a part of every organisation, and that due to legislation it must be.

Most literature speaks of setting standards and protocols so that less occupational and health problems arise. As a co-assessor of the 114 employees screened at CSR Bradford, it can also be concluded that it was beneficial working as a team, achieving experience in a diverse orthoptic role by using people's occupation as a guide to assessment. It also brings to attention the necessary importance of discussing helpful orthoptic and visual advice and recommendations to patients based on their test results, keeping their workplace and occupation in consideration.

It is suggested that if the opportunity arises, orthoptic expertise should be employed in a designed and tailored way, in order to expand the role and awareness of orthoptics within the community.

Acknowledgements

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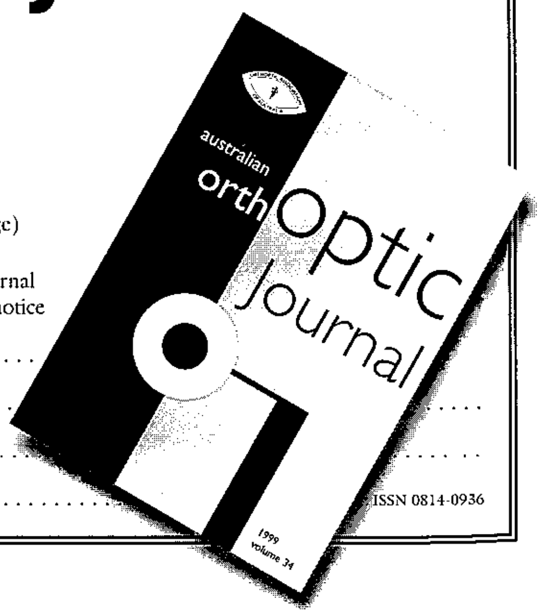

The Orthoptic Treatment of Dyslexia using the LASD

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Abstract

The purpose of this paper is to give a brief background to the development of the Lawson Anti Suppression Device (LASD] and its use and report on a preliminary study to determine whether or not treatment with the LASD could benefit those with Dyslexia.

Eighty patients diagnosed as Dyslexic or having learning difficulties were included in the study. The subjects had a full Orthoptic examination and their reading ability was determined by the Watts Reading Test. The subjects then underwent a course of treatment on the LASD with associated home exercises and were reassessed at the conclusion of treatment.

Keywords:

Lawson Anti Suppression Device (LASD), steady bimacular fixation.

Introduction

In the late '60s and early '70s, research that was carried out by Banks et al[1] on both animals and man determined that cells in the visual cortex responded best to gratings of a certain size (spatial frequency) and orientation. By rotating these gratings through 360° it was postulated that all cells would be stimulated. From this research came the CAM stimulator. Although early results were encouraging (eg. Banks, Campbell, Hess and Watson)[1] further studies found that it was the Near work, not the rotating gratings that improved visual acuity (Schor, Gibson, Hsu and Mah).[2] Hence the CAM stimulator has not been incorporated into many orthoptists' amblyopia treatment regime.

At the time that the CAM was being developed, Alison Lawson also developed a machine, the Lawson Antisuppression Device (LASD). It too used the rotating gratings, however on a larger scale, for easier use. She also incorporated a light source into the machine, which seemed rudimentary, as the eye is stimulated by light.

By the introduction of a peripheral rotation mechanism the LASD has continuity of gratings and has eliminated the central blank spot that exists in the CAM.

There are also significant differences in the way the LASD is used. Treatment sessions last one hour not 7 minutes. In previous studies (Banks et al & Shor et al)[1&2] the amblyopic eye is treated while the good eye is patched.

In the Lawson treatment, a red filter is used to ensure macular fixation in the eye being treated while the good eye is patched in the first treatment only. In the next 4 treatments the red filter is placed over the good eye with nothing on the suppressing eye. Transparencies with predominantly red work are then used over the discs thus ensuring that the suppressing eye is the eye being used. Hence the Lawson method eliminates suppression whilst in a binocular state.

As Lawson was refining the LASD and its uses, a patient enquired as to its applicability to learning difficulties.

During the Orthoptic examination it was discovered that the fixation of one eye was not steady. The patient did not have eccentric fixation, but rather, unsteady central fixation as described by Dayson.[3] This indicated an unsteady fixation around and across the fovea which was not steady enough to quantify as central fixation or parafoveal fixation. While one eye steadily uses the fovea the other eye alternates between the fovea and a non-foveal point. If non-corresponding retinal points are stimulated, the brain has a choice between diplopia or suppression. In almost all these cases the brain suppresses one image, until the eye refoveates.This intermittent use of binocular fixation causes a disruption in the pathway of information through the eye to the brain, resulting in poor learning, concentration and application to a task.

Lawson devised a treatment regime that would fix this wandering fixation. Whilst being seated at the LASD for approximately 45-60 minutes, with the gratings rotating, the patient completes a variety of stencils covering: sequencing, basic sounds and reading, left/right orientation, spelling and visual memory. The largest grating is used on the first treatment and the sizes are gradually reduced. Filters, patches and lenses are used as follows:

1st treatment:
- black patch – non-affected eye
- red filter – affected eye

2nd, 3rd & 4th treatments:
- red filter – non-affected eye
- no patch – affected eye
- (red stencils used)

5th & 6th treatments:
- red filter – non-affected eye +&- 1.00 D.S. and +&- 2.00 D.S. used on both eyes

7th & 8th treatments:
- no red filter +&- 3.00.D.S. on both eyes.

Between the first 3 treatments the patient uses the red filter over the affected eye and the black patch over the non-affected eye at home whilst watching black/white TV for 2 x half hours per day to reinforce the treatment at the clinic. A full range of orthoptic exercises are also given to ensure full convergence, bar reading to N5 and all stereograms can be completed easily as well as a range of remedial work and spelling.

This total retraining of the visual system and its use has shown some remarkable results. The retraining of the unsteady fixation of the affected eye leads to an improvement in the patient's concentration and application to a task and hence reading and spelling improves considerably.

Method

80 patients attending the Alison Lawson Clinic in Moss Vale NSW between March and August 1998 were included in the study. Patients with manifest squint, refractive errors or any ocular pathology were not included. All patients had been diagnosed as dyslexic or having learning difficulties.

A general and ocular history were taken with particular attention paid to symptoms normally associated with dyslexia.

The patient's dominant hand was noted and dominant eye was determined by the cardboard cylinder 'telescope' method.

The Snellen's Chart was used to assess distance Visual Acuity followed by Near Vision, Cover Test, Ocular Movements, CNP, Maddox Wing, Worth's Lights and Wirt Stereotest.

Reading Age (RA) was determined by the WATTS' READING TEST. Finally fixation was assessed. All of the subjects in the study had steady macular fixation in one eye, which is referred to as the 'non affected eye' and unsteady fixation in the other eye, which is referred to as the 'affected eye'.

After the initial assessment patients underwent a course of treatment as previously described.

Results

There were 55 (68.75%) males and 25 (31.25%) females. Figure 1 shows the range of symptoms.

There was a strong familial tendency with 72 (90%) of subjects having a parent and/or sibling with the same condition. There were 8 pairs of siblings in the study.

Age distribution is shown in Figure 2. The range was 5-60yrs. The median was 8yrs. (10 patients).

There were no manifest squints in the group. 51 (63.75%) were orthophoric, 11 (13.75%) were esophoric, 18 (22.50%) were exophoric. There were no significant extra-ocular muscle imbalances with 5 (6.25%) having a slight over action of an Inferior Oblique muscle.

Convergence was generally good with 15 (18.75%) having full and voluntary convergence, 18 (22.5%) with a CNP better than 2cms, a further 33 (41.25%) between 2cms and 5cms. There was one each with a CNP of 10cms and 15cms.

The Maddox Wing showed that all subjects fell into the range of eso 3 to exo 6 with 72 (90%) between 01-exo 2. No vertical deviations were demonstrated.

Worths' Lights revealed 70 (87.5%) of subjects had suppression in the affected eye. The affected eye was the non-dominant eye in 70 (87.5%) of cases. When the coincidence of these two figures was noted we went back to our primary data and discovered that they were in fact the same 70 subjects. In the past, monocular tests of ocular dominance were said to be ineffective in differentiating visual dyslexics, this is clearly not the case in our study. The eye with unsteady macular fixation = the suppressing eye = the non-dominant eye in 87.5% of cases. Cross dominance was present in 29 (36.25%) of cases.

By comparing Figures 3 & 4 it can be seen that there was an overall improvement in V.A. in both affected and nonaffected eyes following treatment. 33 (41.25%) of subjects showed improvement of at least one line in the affected eye and a further 20 (25%) showed improvement of at least one line in both eyes. The remaining 27 (33.75%) had equal vision that did not alter with treatment. 54 (67.5%) demonstrated an improvement in Near Vision after treatment see (Figure 5).

These improvements occurred in eyes that were considered normal and not requiring any treatment. It does make one wonder whether 6/6 should be the norm.

Figure 6 shows the defects in stereoacuity present before treatment compared with the post treatment, i.e. 100% of subjects with stereoacuity to 40 seconds of arc. The improvement in Reading Age is shown in Figure 7. The Reading Ages in the WATT'S READING TEST range from 6.9 to 11.9 at the initial assessment. 8 subjects had a Reading Age of >11.9. As this was outside the parameters of the test we were unable to measure their improvement. There were also 7 subjects who could not read at all before treatment so if they finished the study with a reading age of eg. 7yrs it would only appear as an improvement of 3 months when the actual improvement was clearly much greater. The improvement that we could measure ranged from 6 months to > 48 months. The average was 21.12 months. The period of time over which treatment took place ranged from two to twelve weeks (Figure 8).

Those treated in five weeks or less were interstate patients who would come and have daily treatments for one week, go home with their exercises for a couple of weeks, and return for a second week of daily treatments. The 4 patients who had their treatment over only two weeks had daily treatments for the whole two weeks. The median was eight weeks (29 patients). The number of treatments each patient required can be seen in (Figure 9). The number of treatments to achieve steady bimacular fixation is shown in Figure 10.

	Number of patients	%
Difficulty reading	78	97.50
Difficulty keeping place when reading	35	43.75
Non readers	7	8.75
Dislikes reading	57	71.25
Closes one eye to read	10	12.50
Fatigues with reading	25	31.25
Sore eyes and/or headaches with reading	32	40.00
Poor comprehension	66	82.50
Poor spelling	64	80.00
Slow and/or difficulty with written work	46	57.50
Required scribe	4	5.00
Reversals-letters	42	52.50
Reversals-words	29	36.25
Anagrams	4	5.00
Difficulty with right/left	23	28.75
Difficulty with sequencing	14	17.50
Clumsy/poor gross motor	35	43.75
Poor fine motor skills	5	6.25
No good at any sport	4	5.00
Poor memory and organisational skills	20	25.00
Frustrated	23	28.75
Disruptive in class	8	10.00
Poor self esteem	35	43.75
Tutor	25	31.25
Speech therapy	8	10.00
Occupational therapy	3	3.75
Physiotherapy	1	0.80
Diagnosed Attention Deficit Disorder	8	10.00

Figure 1.
Presenting symptons

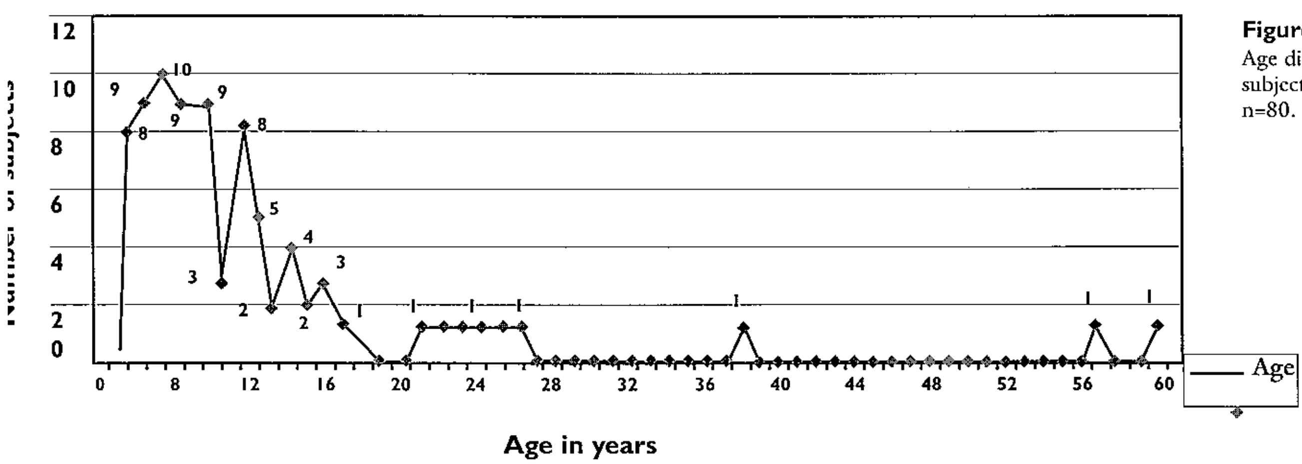


Figure 2.
Age distribution of subjects
n=80.

Figure 3.
Distribution of VA in Affected Eyes.

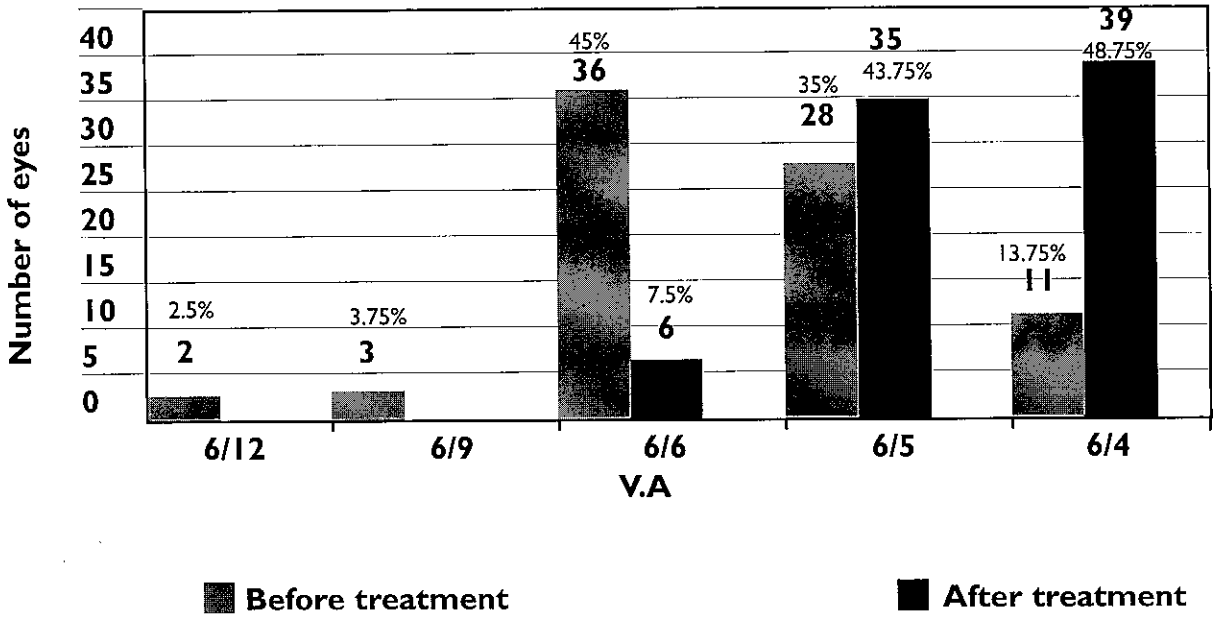
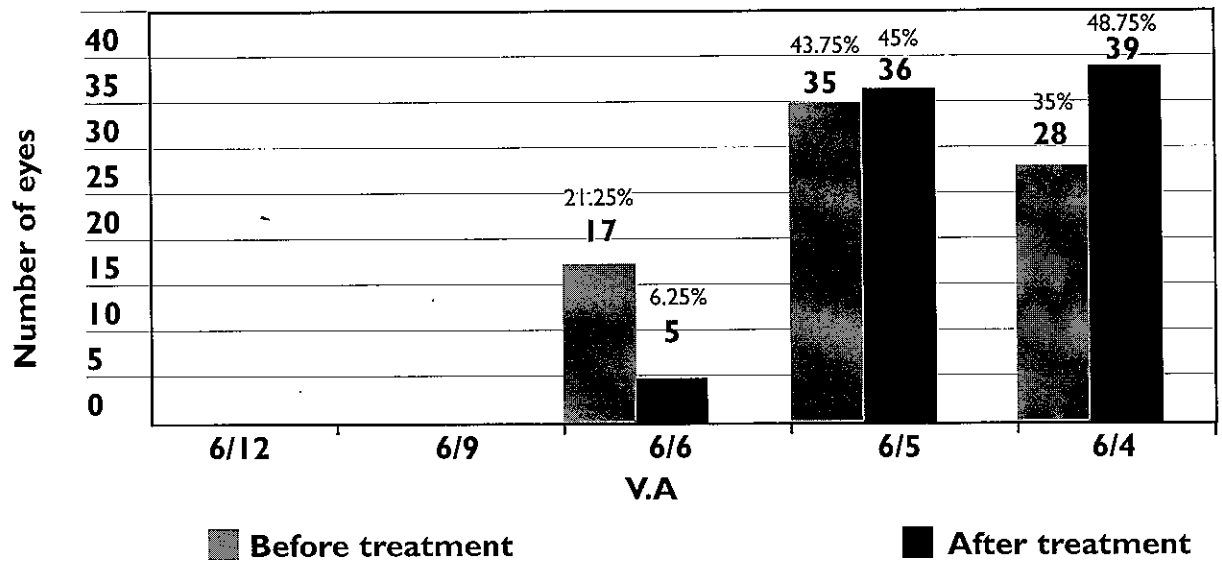


Figure 4.
Distribution of VA in Non-affected Eyes.



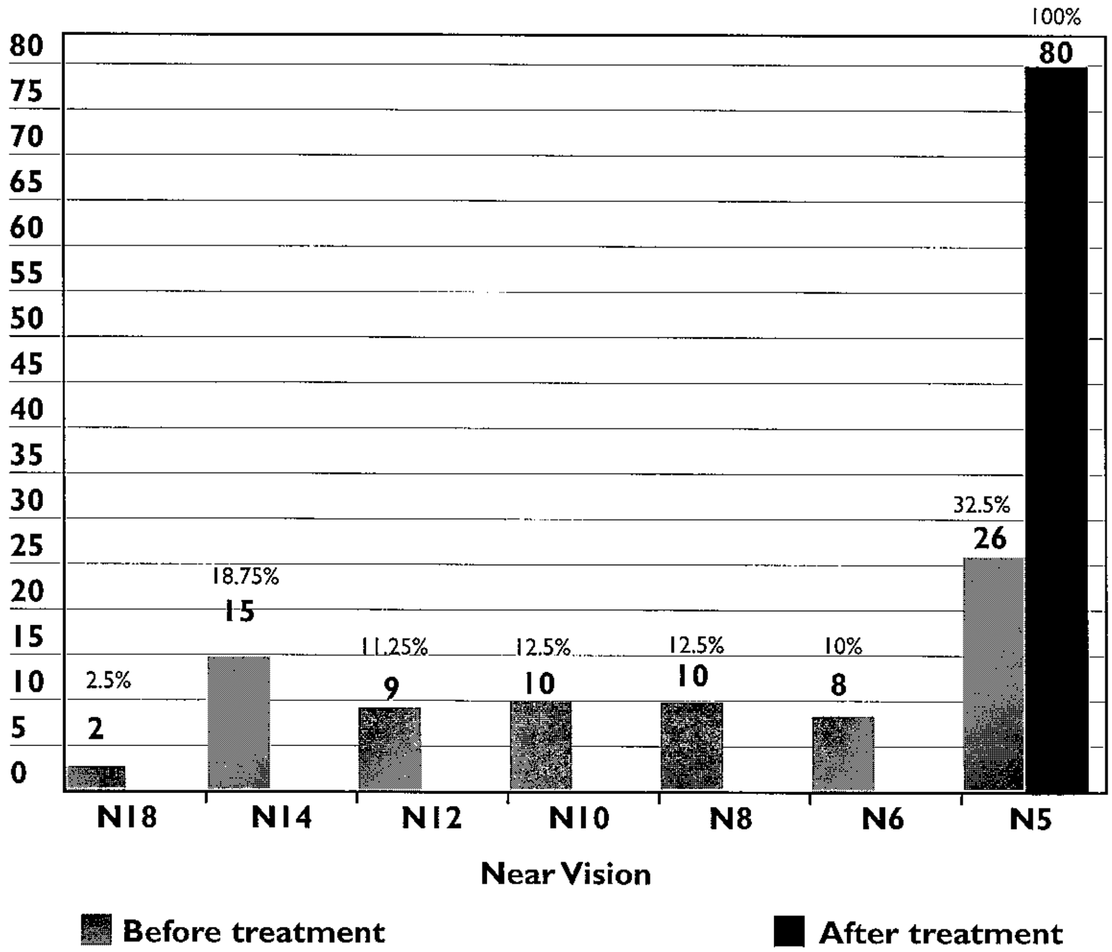


Figure 5. Distribution of Near Vision in Affected Eyes.

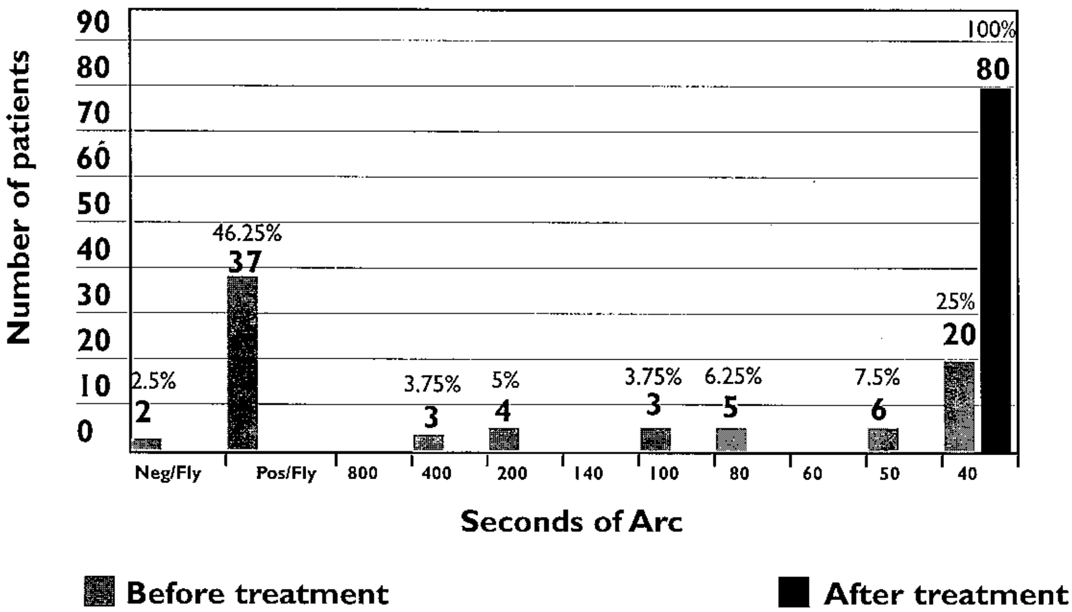


Figure 6. Distribution of Wirt.

Figure 7.
Improvement in reading age.

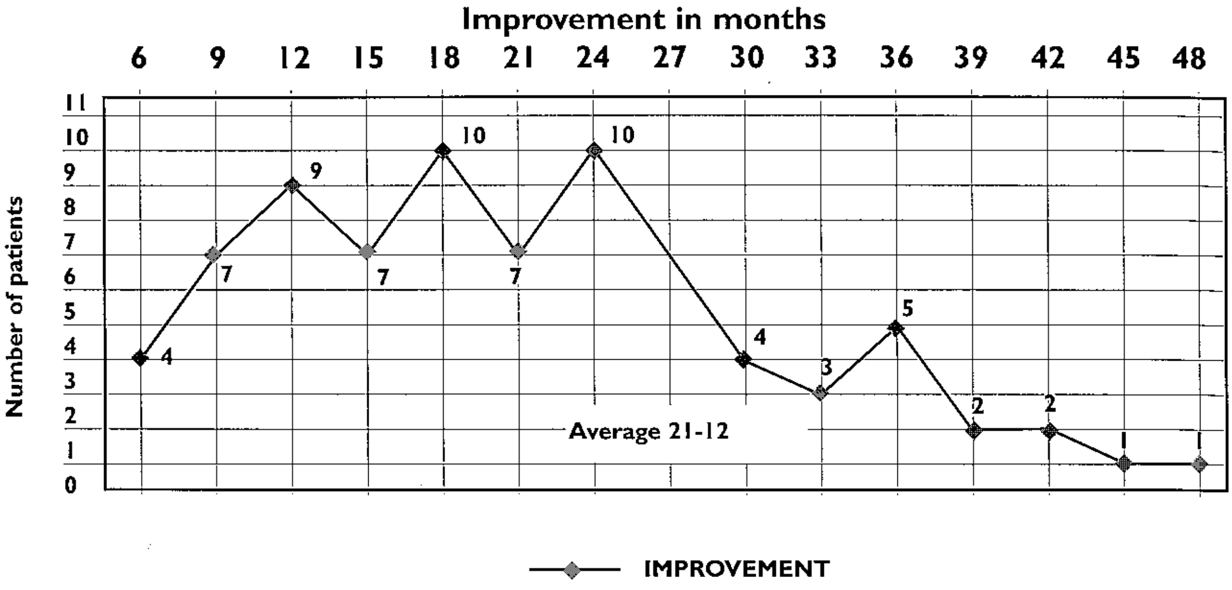


Figure 8.
Period of time over which treatment took place.

WEEKS	2	3	4	5	6	7	8	9	10	11	12
PATIENTS	4	2	4	2	7	5	29	10	10	1	6

Figure 9.
Number of treatments.

TREATMENTS	7	8	9	10	11	12	13
PATIENTS	12	32	23	10	1	1	1

Figure 10.
Number of treatments to achieve steady Bimacular Fixation.

TREATMENTS	3	4	5
PATIENTS	57	20	3

Discussion

At the end of treatment what have we achieved? All patients reported vast improvement in all areas.

66.25% of subjects demonstrated an improvement in Distance V.A.

67.5% of subjects demonstrated an improvement in Near vision. All patients found reading much easier. Before treatment there were 7 non-readers, after treatment there were none. The average improvement in Reading Age was 21.12 months. Of the 57 (71.25%) who disliked reading before treatment 53 (92.9%) now read for pleasure. The 10 patients who found it easier to read with one eye closed no longer feel the need for this. Comprehension has greatly improved subjectively (comprehension was not measured in this study, we hope to include it in a future study). The 4 patients who had required scribes before treatment now felt confident without them. Reversals of letters and words ceased in all patients.

Those who had reported difficulty differentiating between Right / Left found this was no longer a problem.

Improved stereoacuity was shown in 75% of subjects which translated into improved co-ordination in all 35 patients who had been having difficulty in this area and several reported a sudden increase in the number of goals being shot, the number of home runs and one even experienced an increase in confidence in show jumping. Driving became much easier for one subject.

Fatigue, sore eyes and headaches disappeared, memories improved, disruptive behaviour ceased. Increased confidence was reported in 75 (93.75%) of patients. Poor self esteem had been reported in 35 (43.75%) of patients. It was significant that only 2 of these had been under 10yrs of age, 33 of them were adolescents and adults (all of the adults and adolescents in the study). This condition clearly has a major negative impact on their lives. All reported soaring self esteem by the end of treatment. Would these changes have occurred with remedial work alone? 25 (31.25%) of the subjects had already had remedial work and tutoring (in some cases for years) with no improvement. All subjects had explored all other avenues available to them without any significant improvement before they presented to us. Would these changes have occurred with convergence treatment alone? It was a prerequisite of inclusion in this study that the subjects were orthoptically satisfactory (with the exception of 2 patients with less than satisfactory convergence) so convergence treatment alone may have been of limited help to some patients.

It must be emphasised that all 80 (100%) of patients reported improvements in their symptoms as soon as they achieved steady bimacular fixation! In 57 (71.25%) this was by the 3rd treatment.

This is seen as compelling evidence that the absence of steady bimacular fixation was the cause of these problems. The following anecdotes are included for information:

Pt #6 – 12yr old F had 2.5 yrs of tutoring with no improvement. Teacher had stated that she had given up on her and told her parents just be happy with what she can do and don't expect very much. Parents brought her from Melbourne for treatment. In four weeks RA had improved from 7.3. to 10.6.

Pt #20 – 16yr old F Depressed taking Prozac poor self-esteem, 2 suicide attempts. After treatment parents reported her self esteem greatly improved and she was actually happy.

Pt #23 – 12yr M talented musician but not able to read music at all. After treatment passed first music exam ever.

Pt #24 – 6yr old M Non-reader. Doesn't even know letters. SG to test VA. Dyslexia diagnosed - Irlen Lenses prescribed with no result. After 10 treatments over a four week period he was reading with a RA of 6.9.

Pt #40 – 8yr old F with a high IQ but couldn't read at all. Father a school teacher and had given her daily tuition to no avail. Six weeks later she had a RA of 8.3.

Pt #43 – 60yr old F has had poor self esteem all her adult life. She had always felt like a 2nd class citizen. RA improved from 7.9. to >11.9. Now everything makes sense. Now she loves reading and has enrolled in a TAFE course that she had been wanting to do for years.

Pt #65 – 38yr old M "absolutely stoked" RA improved from 8.9. to >11.9 noticed driving easier too.

Pt #74 – 9yr old M gave a very precise description of his suppression scotoma: He complained that letters faded and he would get a grey blur in the middle of what he tried to read (like after looking at a bright light). It wasn't there with either eye closed, only when both eyes were open. This symptom has not recurred since he achieved steady bimacular fixation at the 5th treatment.

Pt #79 – 10yr old M one of 3 children all diagnosed with ADD and taking Ritalin. His paediatrician said he was such a severe case that he would never grow out of it. He had poor reading and writing and required a scribe. He couldn't read small print (all eye check ups NAD) Very poor self esteem. He was in fact suicidal. At the 1st visit he presented as a sullen unco-operative child who would not make eye contact. RA was 8.6. By the 5th treatment he bounced in to the clinic looking forward to the treatment. RA improved to 10.6. Mother says we have transformed their lives. As well as the obvious improvements at school she now has 3 happy children and a peaceful home for the first time ever. Two weeks after treatment finished he went for routine visit to paediatrician who was at a loss to explain the extraordinary improvement in his ADD and now feels he will grow out of it.

Conclusion

The purpose of this study was to determine whether or not the LASD could help those with dyslexia: the answer is most definitely yes.

RA improved an average of 21.12 months in an average eight weeks. This however grossly under states the benefit to the patients and their families who now see endless possibilities where there was no hope.

As is often the case in circumstances such as these we are left with more questions than we have answers. Further studies are clearly required. This is just the beginning.

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Traumatic Superior Orbital Fissure Syndrome – A Case Study

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Abstract

Superior orbital fissure syndrome is characterised by ophthalmoplegia, ptosis and proptosis of the eye, pupil dilation and anaesthesia of the upper eyelid and forehead. This syndrome may be the result of neoplasms of the retrobulbar space, hemotoma and infection of the cavernous sinus, craniofacial fractures and other anomalies in the region of the superior orbital fissure. A fifty nine year old woman presented to the Royal Victorian Eye and Ear Hospital with a complete right ptosis and ophthalmoplegia following blunt trauma. The clinical presentation of traumatic superior orbital fissure syndrome is described.

Key words:
Superior orbital fissure, ophthalmoplegia.

Case Study

A 59 year old woman, Mrs JA was happily gardening at her home one Sunday afternoon in preparation for her 60th birthday party which was to be celebrated the following week. Whilst gardening she turned around and while doing so, leaned over and struck her right eye on the end of a steel rod which was being used as a garden stake. She heard a crack, her eye became quite painful and suddenly closed. Mrs JA felt that obviously something quite serious has just occurred so along with her husband attended the Royal Victorian Eye and Ear Hospital Accident and Emergency Department.

On arrival and initial presentation, Mrs JA complained of a right sided frontal headache with numbness on her forehead and around the right eye. Other initial findings revealed the following:

- complete right ptosis, seen in Figure 1
- complete right ophthalmoplegia, seen in Figure 2
- a mid-dilated pupil, but no afferent pupil defect (APD)
- decreased corneal sensation
- no hyphaema
- densely numb in the region of V1
- a contaminated conjunctival laceration with a posterior track visible in Tenon's plane

Mrs JA's visual acuity was recorded to be Right 6/36, Left 6/6 with normal colour vision on Ishihara testing. Automated visual fields were within normal limits. Fundi were also investigated and showed no abnormalities.

Figure 1.
Initial presentation of Mrs JA with complete right ptosis and mild periorbital bruising and swelling.

Figure 2.
Complete ophthalmoplegia on initial presentation – has the appearance of a frozen eye.

CT imaging was immediately ordered on this day of presentation. The findings strongly suggested some air within the right cavernous sinus with appearances most probably reflecting perforation through the superior orbital fissure on the right side. A prominent amount of oedema was seen within the right orbit, particularly at the orbital apex. No definite bone fracture was identified.

Air within the cavernous sinus presented a risk of cavernous sinus thrombosis. Mrs JA was immediately admitted to the Neurosurgical Ward at St. Vincents Hospital for observation. Notes suggested that thrombosis was unlikely but nonetheless she was kept for observation for 24 hours and placed on prophylactic IV antibiotics. During this time, MR imaging was ordered. Imaging showed no further pathology other than that demonstrated on CT imaging. It did however confirm marked oedematous change throughout the right orbit with a degree of proptosis. The globe and optic nerve appeared intact. Further CT imaging three days later showed the previously noted air in the cavernous sinus to be resorbed with exclusion of any significant cavernous sinus thrombosis. The oedema in the

Figure 3.
Range of extraocular movement at one month post trauma.

Figure 4.
Range of extraocular movement at two months post trauma. Note the significant improvement over the previous month.

ght orbit had also improved considerably.

Mrs JA presented to clinic one month post auma. She felt that her condition had slowly nproved. The ptosis was no longer complete, owever quite marked. Extraocular movements were rossly limited, however a complete phthalmoplegia was no longer noted. There was no ovement of the right eye in up or down gaze and ery little movement in right adduction. The reatest movement seen was on right abduction, beit slight. This is shown in Figure 3.

Mrs JA's presentation at two months (see Figure) post trauma was more encouraging. Her eye emained comfortable and white. The right ptosis nowed great improvement, so too the range of eye novement. The greatest limitation remained in owngaze as well as continued marked limitation on pgaze. Right abduction and adduction had greatly nproved over the previous month, with only narginal limitation in right abduction seen.

Over the past 10 months, Mrs JA's ocular ondition had greatly improved. On last report, a ight limitation in downgaze was noted as well as a nild ptosis. VI(1)CN involvement persisted and she on medication for this. Unfortunately, Mrs JA omplains of excyclotorsion on downgaze. It was ecided by her private ophthalmologist to take a onservative approach, examining her periodically. the symptom of torsion persisted, the phthalmologist was planning surgery.

Discussion

The clinical manifestations of the superior orbital fissure syndrome (SOFS) are a result of injury to the structures that cross it.[1] Findings include persistent periorbital oedema, proptosis, subconjunctival haemorrhages, ptosis and ophthalmoplegia, dilation of the pupil, loss of corneal reflex and cutaneous anaesthesia of the forehead region.[2,3] Incomplete forms of this syndrome or associations with other clinical findings can be found. Kjoer,[4] in 1945, coined the term orbital apex syndrome to describe the clinical features, which include the SOFS and involvement of the optic nerve. A second entity that may have clinical manifestations similar to SOFS is the development of a carotid-cavernous fistula (CCSF). Craniofacial trauma is responsible for this condition in 75% of cases.[5] The cardinal symptoms in CCSF are pulsatile exophalmos, chemosis, a bruit, ptosis, ophthalmoplegia, diplopia and headache. The definitive diagnosis of this entity is determined by an arteriogram of the internal carotid artery.[3] Lastly, the Tolosa-Hunt syndrome also has clinical manifestations similar to the SOFS. Subjects present with severe ocular pain with ophthalmoplegia, it however does respond dramatically to large doses of corticosteroids. Spontaneous remissions may occur with complete or partial regression of deficits. Episodes may occur at intervals of months or years. Unfortunately, lesions responsible for this condition have been confirmed in very few instances.[2,6]

Conclusion

Traumatic superior orbital fissure syndrome is rarely seen. This case continues to amaze those of us who examined and treated Mrs JA particularly as the metal rod lacerated her conjunctiva, travelled beneath her globe not severing any major arteries, veins or ocular muscles in the process, but more importantly not severing her optic nerve which would have resulted in blindness. It is cases like this that will keep me even further away from the garden, especially garden stakes.

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